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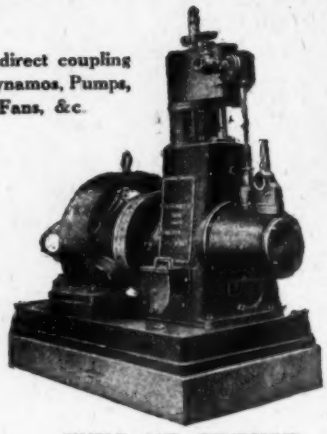

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ELECTRICAL REVIEW.

VOL. XC. JANUARY 20, 1922. No. 2,304.

ELECTRICAL REVIEW.

Vol. XC.] CONTENTS: January 20th, 1922. [No. 2,304.

	Page
A Question of Status	73
The "Movies" at the I.E.E.	74
A District Board for Greater London	74
Battery Locomotives	74
Fixed and Variable Tariffs in France	75
Economics and Happiness	75
The Dielectric Strength of Solid Insulating Materials, by W. S. Flight (*illus.*) (*concluded*)	76
Telephone-line Work in the United States	79
Smoke Abatement	80
Correspondence—	
High-pressure Fuses	81
A Message from Mars?	81
High-frequency Stray Sparks on Motor-cars	81
Mysterious Phenomena	81
Single and Polyphase Commutator Motors	82
A Mountain—or a Mole-hill?	82
Revenue from Power Supply at Lighting Rates	82
Change-over from d.c. to a.c. Supply	82
Commutator Notching Machines	82
New Electrical Devices, Fittings, and Plant (*illus.*)	83
The Electrical Industry and German Reparations	84
Legal	84
Business Notes	85
The "Regent" Theatre, Brighton (*illus.*)	89
Notes	96
City Notes	99
Stocks and Shares	100
The Physical Society of London (*illus.*) (*continued*)	101
The Importation of Foreign Electric Lamp Bulbs	103
The Institution of Electrical Engineers (*illus.*)	104
"Cye-Arc" Automatic Electric Welding	104
The Electrical Trades Benevolent Institution	106
New Patents	108
Published Specifications	108
Contractors' Column	Advertisement page xxx

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A QUESTION OF STATUS.

IT is hardly likely that electricity works officials will be satisfied with the result of the Referee's decision with regard to the compensation claims of the chief engineer of the Morley electricity undertaking (Mr. J. E. Ellis) and his chief assistant (Mr. H. C. Crisp). As the result of an agreement arrived at in April last between the Morley Corporation and the Leeds Corporation, the former discontinued the generation of electricity and took supply in bulk from the latter. This involved, as one of its consequences, the dismissal of a number of employés, and, in our opinion, an alteration in the status of the higher officials at Morley. Claims for compensation therefore arose under the Electricity (Supply) Act, 1919—the first brought under that Act, we believe. As the matter proved incapable of amicable adjustment, the Ministry of Labour appointed Sir William Mackenzie, K.C., to act as Referee. The award has just been issued, and compensation for loss of employment is given in the case of a shift engineer to the tune of £81; one engineman is to receive £198 and another £101; two shift engineers or switchmen are awarded £66 apiece, and the Morley Corporation is to pay these sums. It seems that the interests of the chief, of his chief assistant, and of the dismissed shift engineer were watched over by the E.P.E.A., and those of the other employés by the National Amalgamated Union of Enginemen and Firemen. The Referee came to the conclusion that neither Mr. Ellis nor Mr. Crisp had suffered from the change from generation to distribution only, so as to be in a worse position in respect of their conditions of service, or entitling them to compensation, excepting that in the case of the chief, as he was not, under the new arrangement, in a position to take pupils as he had been doing between 1903 and 1919 (30 pupils aggregating £1,550 in premiums during that period), he was awarded £140 as compensation. It should be mentioned that both officials had been retained in the service of the Morley Corporation at unaltered salaries. In the opinion of the non-technical Referee, Mr. Ellis has not suffered by reason of the diminution of his duties as borough electrical engineer and Mr. Crisp has not suffered, though his duties are now of a minor character compared to what they were formerly, consisting as they do of wiring work and meter testing.

Unless we are very much mistaken, there will be a chorus of disapproval from engineers controlling undertakings which may sooner or later be required to change over from production to mere distribution. Will the Morley Corporation regard the status of the chief and his assistant as unaltered in future salary revisions? Is it likely, however much more energy they may be called upon to *distribute*, that the Corporation will regard the services of these officials as of increasing value just as it would have had to do if it had extended the generating plant and system again and again? If a large part of the responsibilities which have made a man a chief official in charge of an undertaking be taken away from him, is it possible to leave him unaffected either with regard to technical status or with regard to his future prospects in that position or in any other? Or if the chief assistant be deprived of the duty of controlling the operation of a generating and distributing system, subject to his chief, and be reduced to what are, from the standpoint of the engineer, minor duties, are his status and his prospects unaltered? The Referee, unconvinced by the E.P.E.A., says that they are. We say, emphatically, that their circumstances are altered for the worse, that their claims are such as

ought legitimately to be covered by the Act of 1919, and that the award would have been different if the matter had been adjudicated upon by one who was *au fait* with the technical side of electricity supply organisation.

In Section 16 of the Electricity (Supply) Act, 1919, "Compensation for deprivation of employment," there is a clause which is particularly relevant to the case. It provides that compensation is payable where any officer or servant who has been regularly employed in or about the undertaking proves to the satisfaction of a referee or a board of referees appointed by the Minister of Labour that in consequence of the Act he—

(iii) has been placed in any worse position in respect to the conditions of his service (*including* tenure of office, remuneration, gratuities, pension, superannuation, sick or other fund, or any benefits or allowances, whether obtaining legally or by customary practice).

We have italicised the word "including," because it is important as proving that factors such as we have mentioned adversely affecting an official's status are not excluded from the causes placing him in "any worse position in respect to the conditions of his service."

We can hardly imagine that the matter will be allowed to rest where it is. In the meantime, the E.P.E.A. and the other parties have been ordered to pay their own costs in relation to the award.

The "Movies" at the I.E.E.

THE Council of the Institution of Electrical Engineers is to be congratulated on the success of its latest innovation, in the shape of an exhibition of kinematograph films; very rarely have we seen such a large attendance of members—and visitors. It bore unmistakable witness to the popular anticipation of an interesting programme, which was fully realised.

The series of circuit-breaker tests introduced by Dr. C. C. Garrard was full of incident and potentialities of edification; it is given to few to witness the conduct of intentional short-circuit tests on heavy switchgear, and those who assist at unintentional tests of this class are usually not in a fit frame of mind at the time to view them critically and dispassionately. But the majority of the spectators knew pretty well what to expect, and a shout of laughter went up when the first explosion on the screen was apparently followed instantly by a violent displacement of the field of view, suggesting that the operator in charge of the camera was not broken-in to bombs. Whilst we greatly appreciate the interest and value of these observational films, we think it right to add that if they were shown still more slowly, and if the subjects of experiment were much more fully explained, their usefulness would be greatly increased. No doubt the exigencies of the programme influenced these matters, and perhaps, if the audience had been able to follow the speaker's remarks more closely (they were almost unintelligible, if not inaudible, at the back of the theatre, where the best view was obtained), a more favourable impression would have been formed.

The series of views relating to the audion, exhibited by Mr. Frank Gill, cannot be too highly praised. Even the most expert practitioners of wireless telegraphy and telephony must have been pleased and thrilled with the idealistic, if not exactly realistic, representation of the dancing electrons and the marvellous properties of the thermionic valve in its various applications. The imaginative faculties of the author or artist by whom the etheric waves, the electrons, and the sound vibrations were portrayed and the clever analogies were introduced, compel our admiration, and recall the historic moment when our lamented friend Duddell threw on the screen the oscillographic waves of an actual three-phase current, looking just like the text-book diagrams. A profane observer murmured "for ever blowing bubbles" as the sound-waves expanded from the mouth of the pictured speaker to the telephone receiver, thus illustrating once more the narrow margin between the sublime and the ridiculous; but joking apart, the epithet "sublime" would not be inappropriate to the subject and its treatment, and we extend our cordial congratulations to the author, whoever he may be.

The remaining film, partly humorous in respect of the self-building of a telephone instrument and partly illustrative of the many functions fulfilled by telephony, was the only one suited to a non-technical audience. All the films were heartily applauded, and would probably have been encored if that had been possible. If they were all shown again we feel sure there would be a large gathering to see them, and we are pleased to know that they will be exhibited at some of the Territorial Centres.

A District Board for Greater London.

The question of forming a District Board for the Greater London (No. 10) Area has been the subject of two conferences, to which all undertakings in the area were invited. The first of these Conferences passed a resolution that it was desirable to form such a Board, and a meeting to ratify this was subsequently convened, to which every undertaking was asked to send an instructed representative. In other words, every undertaking in the Greater London area was asked to submit its view as to whether it was for or against the formation of such a Board. The issue was quite simple, and the occasion most important. It might have been anticipated, therefore, that on an official occasion of this kind the undertakings in the area, seeing how greatly they might be affected, would have expressed an opinion. Instead of this, when the meeting was held, out of seventy-nine undertakings that were concerned, only about a quarter expressed any views. There is really no excuse for indifference of this kind on so important an issue; it indicates that deplorable lack of industrial constructive effort which has been at the root of so much trouble in the industry.

If the undertakings of Greater London do not want a District Board, it is quite easy for them to send representatives or letters saying they are opposed to the proposal. On the other hand, if they are silent and give no reply, they will have no standing for protesting against the existence of a Board should one be formed. For instance, the London companies, as is well known, have refused to recognise a National Board or a District Board. Notwithstanding this, at the meeting which we have mentioned above, there arrived no communication, except from the Westminster Company, by which any decision could be set down against their names, except by hearsay. Then, again, there was a large number of municipalities which said neither yes nor no, and which are quite as likely as not in the future to disclaim the action of any District Board that may be formed, on the ground that they had nothing to do with it.

Undertakings must, in fact, either want a Board or not want a Board, and on this point they should make up their minds, unless they wish for trouble. There is to be held shortly a further meeting to which every undertaking in Greater London will be invited, and unless the proposal is vetoed at this meeting it will proceed to elect the members of the proposed District Board. There will be no excuse at this third opportunity for any undertaking to neglect to register its opinion, one way or the other.

Battery Locomotives.

DURING recent years the electric locomotive has been rapidly gaining favour, and its use in shipyards, collieries, both for surface and underground haulage, and in big works which have railway facilities, has been expanding. Since the recent disastrous fire at West Hartlepool, its possibilities have been much canvassed. The theory that the fire was started by a spark from a steam locomotive may not prove to be true, but it has been truly said that the wonder would be, not that this was the cause of the happening, but that it should not have happened before.

The extremely low fire risk of the electrically-propelled engine or vehicle is a matter of common knowledge. It is a risk virtually negligible. But the battery engine has other qualities that count more than ever to-day; these are its economical haulage and its convenience. In shunting work, for instance, to which it is being more and more applied, it can do all that the ordinary type of shunting steam engine can do; it can draw loads as great and at twice the speed, whilst there is no loss of time through having to raise a head of steam each morning. When the day's work is over, it is run into the charging station and charged overnight, and it is ready for instant work next morning. If the day's work happens to be much heavier than normal and the drain on the battery so much the greater, a boosting charge, say, during the dinner hour, will restore some 40 per cent. of the total charge, thus increasing the working capacity of the engine.

Lower capital cost, lower operating cost, and its freedom from fire risks are factors that are bringing about a wider adoption of the battery locomotive for transport in and about works. That freedom from fire risks was the reason why the battery engine was adopted for munition factories during the war; it was the only power tractor that could safely be used in these places. It is doing good work in shipyards—at Harland and Wolff's in Belfast, at Govan, in the North-East coalfield—and the L. & Y. Railway (now the North-Western) has built one for use at Clifton Junction, where it has a power station. The engine, which weighs nearly 19 tons, and an Ironclad-Exide battery of 71 kW capacity at the 4½-hour rate. It was designed to handle three loaded 20-ton coal wagons (90 tons) on an incline of one in 189, and was adopted in place of providing five electric capstans at the power station. It can deal with twice the load capacity of the capstans, and at twice the rate of speed, and both capital and operating costs are lower. The capacity of the battery will admit of 3¼ hours' shunting, or four hours' continuous run "light" on the level at an average speed of 20 m.p.h. The advantages of the electric tractor ought to be more widely known.

Fixed and Variable Tariffs in France.

The Société d'Electricité de Paris is perhaps the only French supply company which did not incur any losses through the great increases in the cost of coal during the war and in the two years following the conclusion of the Armistice, which increases brought the prices of coal up to fifteen or twenty times the charges which prevailed in 1913. All the gas and electricity supply companies whose custom it was and is to sell at fixed rates were involved in deficits during the period in question, and it was only after these companies were authorised to raise their sale prices that any improvement began to be manifest in their financial situation. But the directors of the Société d'Electricité de Paris, besides originally establishing a large station equipped with turbo-generating plant, also had the prevision to introduce what was perhaps a novelty in the supply business at that time, namely, a system of contracts with consumers, according to which the latter undertook to pay for supply according to the variations in the prices of coal. Thus payments were and are made on the basis of the prices prevailing in the previous year, with adjustments in some cases at the end of the year. As a result of the adoption of this far-sighted policy, the company has been able to maintain its rate of dividend during all this period at the highest rate (9 per cent.) paid in former periods of peace, whereas the fixed-price companies had to pass through some very difficult times in the seven years in question.

It is necessary to mention that the Société d'Electricité de Paris, which has no right of supply to private consumers in the city of Paris, is chiefly a bulk supply undertaking. Its principal customers comprise the Metropolitan and North-South underground electric railways and the former Paris Omnibus Co., and the Tramway Company of the Seine Departement. In addition, the company distributes in the suburbs north of Paris, at Saint Denis and in neighbouring localities, and the total deliveries in the year ended last June amounted to 148,000,000 kWh and represented an advance over the pre-war period. As to the possible effects on the company of the recent amalgamation of various supply companies in the vicinity of Paris, the chairman of the Société d'Electricité de Paris informed the shareholders at the annual meeting that the fusion was prompted by the desire to secure uniformity and economy, but that it did not appear that the amalgamated undertakings would supplant the Société d'Electricité, which principally works for the transport companies. For that matter, he remarked, the Paris agglomeration is sufficiently vast for several companies to be able to work and prosper side by side.

Economics and Happiness.

In a lecture having the title "Economics and Happiness," which he delivered a short time ago at the London School of Economics, Sir Arthur Steel-Maitland made some points which should be borne in mind by those who are accustomed to talk loosely of political economy. It is one of the most elusive of sciences, and, as the lecturer pointed out, it is one upon which your ordinary platform orator can talk with apparent wisdom, because the phrases which he uses are those which we are accustomed to hear in common parlance. One may mention the law of supply and demand, capital and labour, without being brought to book, because the meaning of the words is not clearly defined. On the other hand, if an ignorant person essays to discourse on any other science he is soon detected by his inexact use of technical words. In developing his theme, Sir Arthur went on to point out that at the present moment the country is both uneconomic and unhappy, and that it is unhappy largely because it is uneconomic. We should like to go on to say that it is at present uneconomic largely because of the false doctrines which are being daily preached on platforms and street corners in all parts of the country. "It is the duty of the Government," says the man on the barrel, "to provide work and maintenance for every willing worker!" but he does not think it necessary to point out that the only way in which the Government can perform this duty is by encouraging the owner of capital to embark upon profitable enterprise. We use the word "profitable" advisedly because it has been proved again and again that no business can be properly run unless it is run at a profit. And when work has been provided it is necessary for the worker to give an adequate return for the wages paid to him. Unless he does that it is not possible for the Government or for capital, adequately and reasonably supported by Government, to provide the necessary work.

Of all the cries uttered to mislead the working classes there is none more dangerous or insidious than "Down with the Capitalist!" The Socialist who preaches this doctrine knows well that it goes down with those who listen to him; but he knows equally well that were it not that some people are prepared to risk their capital in industrial enterprise there would soon be no work for any worker, willing or otherwise. The Socialist, if it suited him, could easily find examples which the working man would readily understand. A man finds there is coal at great depth under his land. He wants to reach and work it. He has to face the risk of sinking a shaft at enormous expenditure of time and money, and a large percentage of that money has to be spent in wages. Where is the money to come from if not from capital? Owing to our present uneconomic position, the capitalist has become very wary about embarking on new enterprises. As we have stated quite lately, it is the revival of confidence which alone can bring stability which will warrant those who use their own and other people's capital, in launching out on a hundred and one large employment-producing enterprises.

THE DIELECTRIC STRENGTH OF SOLID INSULATING MATERIALS.

By W. S. FLIGHT, A.M.I.E.E., M.A.I.E.E.

(*Concluded from page* 41.)

The curves in fig. 13 show results obtained on various numbers of layers of varnished cloth, and from the analysis of these results given in Table II it is seen how the percentage decrease in dielectric strength increases as the number of layers is increased.

6.—Thermal Capacity of the Electrodes.

Sufficient has already been said regarding the very vital effect on the dielectric strength of the temperature of the insulation to enable it to be readily understood that the thermal capacity of the electrodes may under certain conditions exert an influence on the breakdown voltage obtained. Figs. 14 and 15 show some results observed during tests on varnished cloth and fullerboard with brass electrodes weighing about 1 lb. each, and also with electrodes composed of insulating material carefully shaped to exactly the same size and form as the brass electrodes and afterwards covered with thin copperfoil. The curves show that with either kind of electrode the instantaneous breakdown voltage is the same; this is probably because the brass electrode has not time to absorb the heat and lose it through conduction and radiation. During these tests it was also found that the difference between the results obtained with the two kinds of electrodes became less as the initial temperature of the sample was increased. When the tests were carried out at 100 deg. C. the time-voltage curves for each set of electrodes practically coincided.

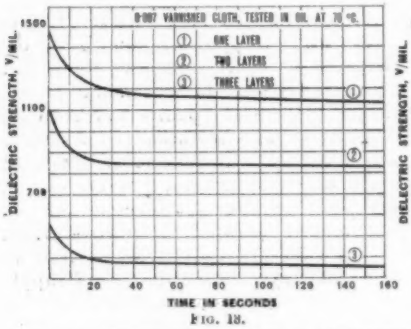

0·007 VARNISHED CLOTH, TESTED IN OIL AT 70 °C.
① ONE LAYER
② TWO LAYERS
③ THREE LAYERS
DIELECTRIC STRENGTH, V/MIL.
TIME IN SECONDS

Fig. 13.

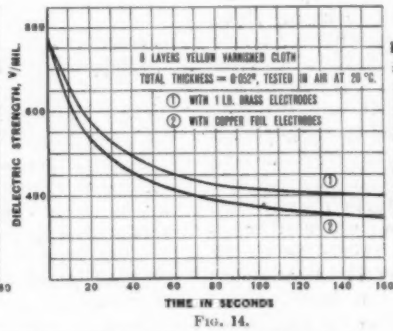

8 LAYERS YELLOW VARNISHED CLOTH
TOTAL THICKNESS = 0·052", TESTED IN AIR AT 20 °C.
① WITH 1 LB. BRASS ELECTRODES
② WITH COPPER FOIL ELECTRODES
DIELECTRIC STRENGTH, V/MIL.
TIME IN SECONDS

Fig. 14.

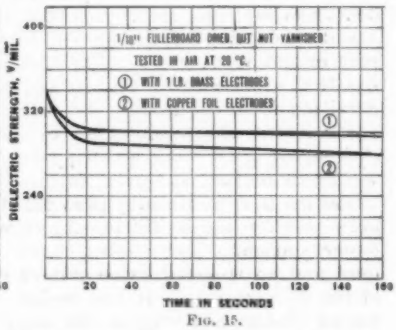

1/16" FULLERBOARD DRIED, BUT NOT VARNISHED
TESTED IN AIR AT 20 °C.
① WITH 1 LB. BRASS ELECTRODES
② WITH COPPER FOIL ELECTRODES
DIELECTRIC STRENGTH, V/MIL.
TIME IN SECONDS

Fig. 15.

Fig. 13.—Effect of the Time of Application of the Voltage on the Dielectric Strength of Various Thicknesses of Varnished Cloth. (See Table II).

Figs. 14 & 15.—How the Dielectric Strength of Eight Layers of Varnished Cloth and 1/16 in. Fullerboard Varied with the Thermal Capacity of the Electrodes.

Fig. 16.

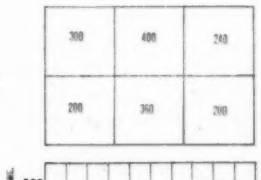


Fig. 17.

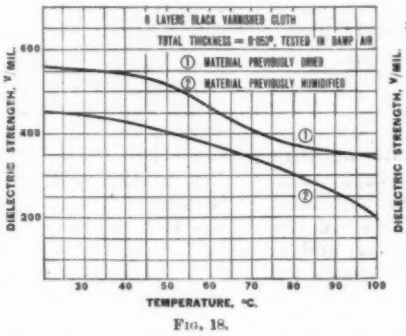

8 LAYERS BLACK VARNISHED CLOTH
TOTAL THICKNESS = 0·052", TESTED IN DAMP AIR
① MATERIAL PREVIOUSLY DRIED
② MATERIAL PREVIOUSLY HUMIDIFIED
DIELECTRIC STRENGTH, V/MIL.
TEMPERATURE, °C.

Fig. 18.

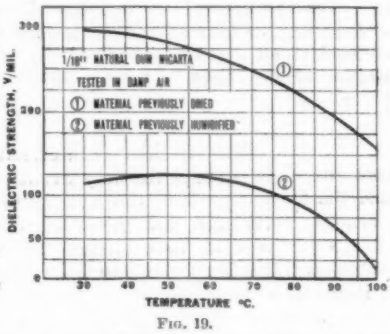


Fig. 19.

Fig. 16.—A Piece of Insulating Material Covering every Condition of Strong and Weak Spots, and Assumed to have the Dielectric Strength Shown.

Fig. 17.—Showing the Influence of the Radius of the Edge of the Electrode on the Dielectric Strength of Varnished Cloth. (Diameter of flat piece of electrode was maintained at 5 cm.)

Figs. 18 & 19.—Difference in Dielectric Strength of Dry and Humidified Varnished Cloth and Micarta.

TABLE II. (from fig. 13).

No. of layers of varnished cloth.	Dielectric strength when voltage is applied for one second.	Dielectric strength when voltage is applied for 100 seconds.	Per cent. decrease in dielectric strength calculated on dielectric strength for one second application.
	Volts per mil.	Volts per mil.	
1	1,500	1,140	24
2	1,140	840	26
3	550	370	32

7.—Size and Shape of Electrodes.

Although during investigational work various experimenters have employed all shapes of electrodes,* including needle-points and spheres of various diameters, it is usual during commercial tests of solid insulating materials to employ flat plate electrodes. Even when the latter are used, the results obtained are influenced by:—

(*a*) the area of the plates, and

(*b*) the radius of the edges.

(*a*) *Area.*—Practically all solid insulating materials are heterogeneous to some extent, and are therefore liable to contain both strong and weak spots. The value for the dielectric strength obtained with large electrodes may thus be different to that obtained with small electrodes. In fig. 16 is shown a piece of insulating material sufficiently large to cover every condition of weak and strong spots which may be expected with this class of material. Divide the sheet into six equal parts, each of area A, and imagine the strength of each square to have the value shown in fig. 16. With electrodes of area A, six tests are required to go over the whole piece; with electrodes of area 2A, three tests; with 3A, two tests; and with 6A, only one test. The results obtained may be as shown in Table III.

*The variation in breakdown voltage with these electrodes used with solid dielectrics is very similar to the variation observed in the case of gases: for which see "Spark Over Voltages through Air," by the same author, in B.E.A.M.A. *Journal* for November, 1920.

From the above it will be seen that the smaller the area of the electrodes the greater will be the figure obtained for the dielectric strength, if this is calculated on the average, as is usually done. As the area of the metal parts in contact with the insulation in an electrical machine may be many hundreds of times greater than the area of the electrodes which can conveniently be employed during the routine tests of the insulating materials, it is very desirable that the minimum figures

TABLE III.

Area of electrodes.	No. of punctures.	Total area covered.	Dielectric strength. Max.	Min.	Average.
A	6	6A	400	200	300
2A	3	6A	360	200	280
3A	2	6A	240	200	220
6A	1	6A	200	200	200

obtained on the routine tests should be employed in calculating the thickness of insulation required, and not the average figure, as is so often done.

(*b*) *Radius of Edge.*—If insulating materials could be tested and used between electrodes consisting of planes of infinite area, the insulating material would be subjected to a uniform dielectric flux. In all commercial electrical apparatus the electrodes are always of such a shape as to produce what is known as an edge effect. This means the concentration of the dielectric flux at the edge of the conductor, whether that edge be a sharp angle or whether it be a curve. The sharper the edge the greater the flux density, and consequently the lower the voltage required to break down the insulation. Fig. 17 shows some results recorded by Mr. M. E. Tressler.* These were obtained on ten thicknesses of varnished cloth, and show how the breakdown voltage increases with an increase in the radius of the edge of the circular plate electrodes. The intensity of the stress increases at the edge as the radius of curvature decreases, so that when the strain at the edge reaches a certain value which is the dielectric strength of the material, breakdown occurs. For convenience in commercial testing the radius of the edge cannot be made very large, and so the stress at the edge is always greater than the stress at the flat part of the electrodes. This accounts for the fact that it is the exception rather than the rule to obtain a puncture under the flat portion of the electrode, the breakdown being almost always on the circumference of the circle bounding the flat portion.

8.—Moisture Content.

In the case of absorbent materials, the dielectric strength is very largely influenced by the quantity of moisture contained in the material. In mines, docks, ships, &c., the relative humidity is about 100 per cent. during a large part of the year, whilst on wet days, and especially during fog, the relative humidity of the air in factories, on electric trains, &c., may be as high as 100 per cent. If a motor cools down in a damp atmosphere, moisture is drawn into the capillary tubes of the fibres in the insulation. Lord Kelvin* has shown that the vapour pressure in tubes of the diameter met with in cotton and paper fibres is sufficiently low to cause water from the air to be condensed in them at ordinary temperatures. Moisture is thus readily condensed in and is difficult to drive out of such insulations. For this reason it is very desirable that the dielectric strength of insulating materials should be obtained under such conditions of humidity as may be experienced under service conditions. Fig. 18 shows temperature-voltage curves for a batch of varnished cloth, part of which was dried at a temperature of 80 deg. C. for 24 hours, and the other part suspended for 48 hours in a closed box in which a dish of water at 25 deg. C. was placed, thus maintaining a relative humidity of 100 per cent. After this treatment, all the samples were tested in an oven containing a tray of water; this latter was considered necessary because in an electrical machine the insulation is usually so boxed up that it cannot readily get rid of its moisture when its temperature is raised, and under such conditions the humidity of the air surrounding the insulation is often as high as 100 per cent. Similar results obtained on micarta are shown in fig. 19. The large difference at the operating temperature (75 deg. C. to 85 deg. C.) between the humidified and dried samples shows that when dielectric strength values are required for the purpose of designing electrical machinery, it is very necessary that tests

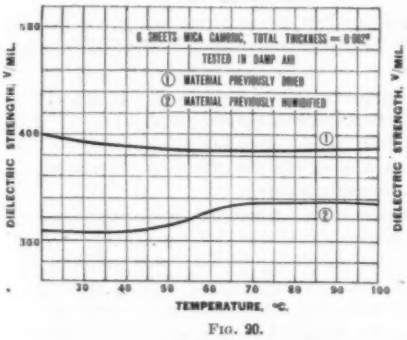

6 SHEETS MICA CAMBRIC, TOTAL THICKNESS = 0·012"
TESTED IN DAMP AIR
① MATERIAL PREVIOUSLY DRIED
② MATERIAL PREVIOUSLY HUMIDIFIED
DIELECTRIC STRENGTH, V/MIL.
TEMPERATURE, °C.

Fig. 20.

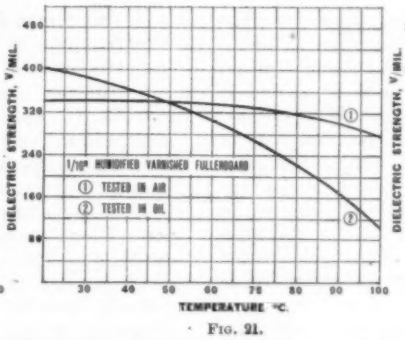


Fig. 21.

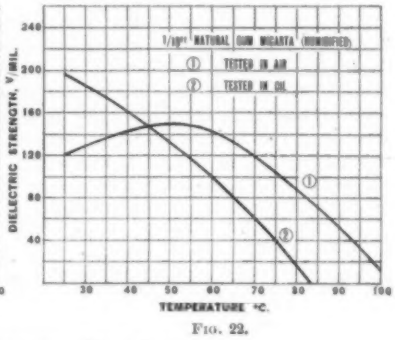


Fig. 22.

Fig. 20.—Difference in Dielectric Strength of Dry and Humidified Mica Cambric.
Fig. 21.—Difference in Dielectric Strength of Fullerboard when Tested in Air and Oil.
Fig. 22.—Difference between Tests in Air and Tests in Oil in the Case of Micarta Plate.

should be carried out on humidified samples, unless it is known for certain that the machinery will never be exposed, after it has been dried out and installed, to a damp atmosphere. Thus in the case of oil-immersed apparatus the dielectric strength of the dried samples may safely be employed in calculating the thickness of the necessary insulation, but for standard lines of motors and switchgear, the humidified values should be used, as it is very likely that such apparatus may be installed in places where the humidity is high. Electrical equipment intended for electric trains, tramcars, docks, ships, and mines, &c., call for special consideration from the point of view of moisture absorption, and in the majority of these cases the extra expense of mica insulation is fully justified by the greater reliability which its use ensures. Curves for mica cambric insulation exposed to damp and dry conditions are shown in fig. 20, from which it will be seen how little the dielectric strength decreases in comparison with the absorbent materials shown in figs. 18 and 19.

9.—Tests Carried Out in Air or in Oil.

For convenience it is customary to carry out routine tests of insulating materials in air, and only to immerse the sample in oil when it is of such dimensions that flash-over would occur before puncture if tested in air. Under certain conditions, however, very different values are obtained for the dielectric strength, depending on whether the test pieces are surrounded by air or by oil. There are two principal causes for this:—

*See *General Electric Review*, March, 1913.

**Electrician*, March 28th, 1919.

(*a*) Due to the difference in the distribution of the dielectric field, and

(*b*) Due to the difficulty of driving off any moisture in the material.

(*a*) *Dielectric Field.*—When two metal parts are separated by a solid dielectric and maintained at a difference of potential, the dielectric flux is not uniformly distributed, but is more concentrated at the edges than on the centre portion of the electrodes. The degree of concentration at the edges depends on the relationship between the specific inductive capacity (S.I.C.) of the solid dielectric to that of the surrounding media. Air having a lower S.I.C. than solid dielectrics results in considerable concentration of the flux at the edge of the electrode, whilst if tests are carried out in oil, the flux distribution is made more uniform, due to the S.I.C. of the oil being nearer to that of the material under test. As breakdown takes place as soon as the voltage gradient exceeds the dielectric strength of the solid dielectric, it follows that the voltage required to produce breakdown will be lowest when the tests are carried out in air. This is illustrated by the low temperature readings in figs. 21 and 22. As soon as the voltage gradient at the edges of the electrodes exceeds the dielectric strength of the air or the oil, corona is formed around the electrodes. The effect of corona is to distribute the edge effect over a band surrounding the electrode, and so reduce the flux distribution at the edge of the electrode. The following illustrates this fact: If a sheet of good insulating material is tested in air, using a needle point as one electrode and a flat plate as the bottom electrode, corona forms previous to breakdown, and spreads out over the surface of the insulation. If a few breakdowns are obtained under these conditions and similar tests are then made with a drop of oil surrounding the needle point, it will be observed that in the latter case no corona is formed, thereby causing the dielectric flux to be concentrated at the point of the needle, which results in breakdown taking place at an appreciably lower voltage than when corona was permitted to form. From consideration of the distribution of the dielectric field alone it cannot be stated for a general case which method of test will give the highest dielectric strength, and the other factors which influence this need consideration.

(*b*) *Moisture.*—Practically all fibrous insulating materials when tested in a normal condition contain a certain percentage of moisture. When voltage is applied to the insulation, so-called leakage currents flow through the insulation, and by so doing raise the temperature of the insulation above the temperature of the surrounding media. This causes the moisture in the insulation to be driven out, and drops of water are often seen condensed on the underside of the electrodes if examined immediately after the breakdown of a piece of damp material. When tests on such materials are made in air, the moisture freely escapes, and if the voltage is raised sufficiently slowly, it is quite possible to use the leakage currents to very effectively dry out the material under the electrodes. As the moisture content decreases, the dielectric strength increases, and consequently higher values are obtained than would be the case if the moisture was retained in the insulation. When the material is tested under oil, this moisture cannot escape unless the temperature of the oil is well over 100 deg. C. Figs. 21 and 22 show results of tests on fullerboard and micarta, and clearly indicate the extent of the reduction due to oil sealing in the moisture. From these curves it is evident that very great care should be taken to thoroughly dry out all oil-immersed apparatus before the insulation is immersed in the oil. When surrounded by air, fibrous insulating materials comparatively easily take up and get rid of moisture, but when surrounded by oil they can only with difficulty absorb or get rid of moisture.

Conclusions.

From the above remarks it is seen that there are so many factors which influence the dielectric strength of solid insulating materials, that it is a truism to say that within fairly wide limits any piece of solid insulating material can be made to have almost any dielectric strength. In other words, it is absolutely essential that the test conditions should be either stated or distinctly understood, in order that figures quoted for dielectric strength may be of any use. Although millions of dielectric strength tests have been carried out in practically all civilised countries of the world, there is not at present any recognised standard of test conditions for the determination of dielectric strength. Consequently there is often difficulty in getting results to compare with those of other experimenters, even when the tests are carried out on materials of the same quality. The choice of the most suitable test conditions is a very wide one, and calls for the most careful consideration of those who have had practical experience in testing insulating materials. The conditions selected should be subject to the following considerations:—

(*a*) They should represent as closely as possible the conditions under which the insulation will have to operate in service.

(*b*) They should be of such a nature that results can be obtained in the shortest possible time. This is most necessary for routine testing where many samples have to be handled each day.

(*c*) They should be such as to reduce the personal element to a minimum.

Recommendations.

In this connection a few suggestions are given for the determination of the dielectric strength of solid insulating materials:—

1. The test equipment should conform as closely as possible to the requirements mentioned under "Test Equipment" earlier in this article.

2. The temperature of the sample and the electrodes should be approximately 90 deg. C.

3. As it is impossible to construct a standard thickness voltage curve which would be applicable to all grades and kinds of solid insulation, and as each material is used in a large number of thicknesses, it is desirable that the value for the dielectric strength should always be suffixed or prefixed by a statement regarding the thickness to which this value refers. When the material is usually employed in service in a less thickness than 1 cm., it is customary to express the dielectric strength in volts per mil (1 mil = one thousandth of an inch), and when used in greater thicknesses than 1 cm., the dielectric strength is expressed in kV per cm.

4. If the information is required for the design of electrical machinery, the shape of the test pieces should be such as to produce as nearly as possible the same distribution of electric field as will be likely to occur under service conditions. For comparative purpose only the shape of the insulating materials should, whenever possible, be a flat plate.

5. As the standardisation rules specify one minute as the length of time during which the h.v. test on finished machines is to be applied, it is essential that all figures obtained for dielectric strengths should be based on the maximum voltage which the material will withstand for one minute. This can be determined by first running the voltage up at the uniform average rate of 1,000 volts per second, and then attempting to apply 75 per cent. of this voltage for one minute. From the result of this second test the maximum voltage the material will withstand for one minute, can soon be ascertained.

6. The electrodes should consist of a material of low thermal conductivity and low specific heat, covered with metal foil about .005 in. thick.

7. The area of the electrodes should be about 4 sq. in., and the effect of the size of the electrodes should be taken into account by calculating the dielectric strength on the lowest breakdowns obtained and not on the average. To overcome the variation due to the variation in the radius of the edge, it is suggested that square edges should always be used. The metal parts of an electrical machine have frequently very sharp edges. A 2-in.

cube of insulating material covered with metal foil has been found to form a very suitable and convenient electrode.

8. To wipe out as far as possible the past history of the material, which may have been artificially dried before being submitted for test, the samples should be suspended for 24 hours in a humidifier (a closed box containing water at the bottom) and kept at about 25 deg. C.

9. If the insulation is intended for use in non-oil-immersed apparatus, the breakdown voltage tests should be carried out in an oven containing a dish of water, so as to give 100 per cent. humidity at the test temperature. If the insulation is intended for use in oil-immersed apparatus, the voltage test should be carried out in oil of commercial purity (say, having a breakdown voltage of 14,000 volts when tested between needle points spaced horizontally and $\frac{1}{8}$ in. apart).

As the correct determination of the dielectric strength is the very foundation of all insulation design, and as the reliability of all electrical machinery so very largely depends on the insulation, it is hoped that the above remarks will stimulate an interest in this very important subject, and that before long some standard method of conducting this test will be evolved.

[Erratum.—On p. 40 of our last issue, the note in small type appearing under fig. 7 should have been placed under fig. 10, to which it relates.—Eds. Elec. Rev.]

TELEPHONE LINE WORK IN THE UNITED STATES.

Discussion at Liverpool.

At the Liverpool Sub-Centre of the North-Western Centre of the Institution of Electrical Engineers, on November 27th, 1921, Mr. E. S. Byng's paper on the above subject (abstracted in our issue of November 25th) was read, and in opening the discussion Mr. A. J. Eames said that he did not think that telephone engineers in England could readily avoid comparing American and British practice. Indiscriminate criticism of American methods would be very inappropriate, as the greatly varying conditions made differences inevitable; other factors, such as the life of plant, annual maintenance charges, and depreciation, also entered into the question. The wider open spaces in America permitted of plant being designed of a strictly utilitarian type, and ugliness was not so conspicuous. With regard to the relatively greater humidity of the British climate, for example, the use of glass insulators with wooden spindles, and the drop wiring system would be unsatisfactory owing to insulation losses.

No reference was made to any scheme for the technical training of the junior grades of the engineering staff. On the whole, the work was organised on similar lines in this country. Development studies in America proceeded on almost identical lines. Some of the information sought for might be considered as being of too searching a character, but experience strongly confirmed that statistics of a very complete kind were essential to avoid waste of capital, or costly and premature replacements of serviceable plant. The provision of cable stubs at suitable branching-off points along the main cable was a useful device for obtaining flexibility in cable pair distribution. Teeing on at the main cable joint was a disadvantage which would, perhaps, be better avoided by looping pairs through the stub cable. He was unable to accept the suggestion (without some reservation) that the arrangement prevented faults; the risk was, to some extent, shifted from the main cable joint to the stub cable. The method described in Section 5 of erecting aerial cables was generally sound, particularly with regard to the short spans. The practice of driving two bolts transversely through the pole, instead of carrying a band round the pole, to secure the clamp, unnecessarily weakened the pole. Greater care had to be taken of telephone poles in this country, as the majority were imported, and they were extremely costly, for which reason it was necessary to set them farther apart. The opinion was rather widely held that marline, a vegetable substance, had deleterious effects on lead sheathings in damp atmospheres—rawhide strips for hanging and tying up the cable to the suspender wire were preferred. The 24-in. arm spacing, instead of 12 in., would very seriously limit the wire carrying capacity of poles, but must considerably minimise the risk of faults if the wires were properly regulated.

Mr. A. J. Pratt said a significant statement was "that no small measure of direct responsibility rests with the chief engineer in the matter of providing a fair return." That was a sound principle, capable of wide application in spheres of labour generally. It was a matter of surprise to find that American engineers made such a liberal use of concrete. Cases of damage to ducts in England were very rare. In laying earthenware conduits through large towns and cities it happened that in probably 90 per cent. of the cases the conduit had necessarily to be laid at a greater depth than the standard 24 in. in the carriageway, owing to the presence of foreign mains and obstruction, which was an additional protection.

As regarded pressure testing, it would seem a wise precaution to pressure-test main cables after the completion of the plumbing operations. It would be a difficult matter to ensure a perfectly hermetically sealed lead tube, say, from Birmingham to Liverpool, by relying upon the plumbers' work alone. Moreover, the cost of pressure-testing by either dried air or CO_2 was comparatively small as compared with the cost of renewing a length or so of expensive main cable. Again, as regarded the insulation resistance, they used in this country the desiccator as the construction work proceeded, and on completion of the cable they had a perfectly sealed tube, all leading-in points having been eliminated, and they could, if desired, obtain an insulation resistance of 50,000 megohms per mile. Subsequent to the initial desiccating operations there was no further need to desiccate unless a fault occurred. To renew the length would probably necessitate rebalancing over a long length—perhaps half a mile—a very expensive operation.

Mr. F. Mercer explained that one feature which tended to distinguish American practice from British was the dependence of the former on the skill of their workmen, which appeared to be such that faults attributable to bad workmanship were so few and unimportant that it was not worth while taking steps for their elimination. In America it appeared that pressure-testing was not carried out, presumably because the expense was too great, and it was preferred instead to risk occasional faults in the lead sheath, which might admit moisture, and in turn either create a definite fault or cause electrical unbalance between the wires of a four-wire core, and therefore cross-talk between the three circuits in that core.

One could but admire the flexibility and vision evidenced in the American system. It was only necessary to refer to the cable racking of large man-holes whereby any cable joint in the man-hole could be readily made or altered without interfering with other cables, to balloon joints in a cable whereby additional circuits could be loaded without undue difficulty, to stub cables by which a flexible distribution was ensured, and to the use of aerial cable with terminals on the carrying poles whereby new subscribers could be readily connected, in order to see the high standard which had been attained in that respect.

Mr. H. Adams agreed with the author that the stub cable method appeared good for increasing the flexibility of the u.g. system, but what precautions were taken to prevent faults developing in the stubs? The methods employed for superimposing lines on aerial lines were remarkable. He and many others had spent hours on balancing lines to prevent overhearing on the superimposed circuits, which were called "plus trunks." Sectional tests were made in order to pin down the trouble to some particular section, but no one defect that would cause the trouble could be found. The trunks in question were about 30 miles long, and included underground and aerial cables and open line. The only conclusion they could arrive at was that the insulation resistance and capacity of the open lines (which passed through trees) were greatly and unevenly affected by the ever-changing atmospheric conditions. Those plus circuits never did work satisfactorily. Drop or vertical joints on aerial cables consisted of a closed lead sleeve with an externally threaded brass collar, which was fitted on to an internally threaded brass collar. The screwed joint was made damp proof by the use of a rubber ring or washer; the two ends of the cable to be jointed were brought into the top of the collar, and the space between the cables and collar was securely closed by a wiped joint. The great advantage claimed for the joint over and above the horizontal type was accessibility of conductors for changes or tests. The moisture-proof qualities of the joint were claimed by Kempster B. Miller to be perfect, but the speaker considered the mechanical construction very weak on account of the expansion and contraction of the cable affecting the wiped joint. With the crank handle method of twisting, on account of looseness of joints, continuity had been interfered with. Experimental tests with a buzzer and an exploring coil—really an induction coil—so far as aerial cables were concerned, presented no real difficulties. Underground cable testing by that method was quite a different proposition, as the iron conduit around the cable appeared to act as a magnetic screen.

Mr. C. F. Bolton confined his remarks to that portion of the paper that dealt with underground cable work, and was greatly interested to hear that ducts were laid on a 4-in. concrete foundation, as he was of the opinion that that was a most important point, especially in cases where the external diameter of the cable to be installed approximated that of the internal diameter of the duct. His experience had been that when the duct line was laid without a rigid bed (referring to glazed earthenware ducts with spigot and socket joints, as used by the British Post Office) irregularities might occur in level at pipe-joints, and an accumulation of those irregularities in a duct section constituted a serious source of friction when a length of cable was being drawn in. Under those conditions the sheathing of the cable was subjected to very great strain, and to prevent that he considered the provision of a concrete bed for obtaining the correct level would be well repaid. In the case of underground balanced-trunk cabling the speed of drawing-in determined, within certain limits, the rate of progress of the whole work. The practice of

always providing a draw wire in one duct when a conduit line was being installed was sound, as it might be assumed that when a conduit route was installed cabling operations would follow immediately; much time and expense was therefore saved by precluding the necessity of rodding operations.

The author stated that concrete was now more frequently used in manhole construction. That was no doubt cheaper when a clear run could be obtained, but the speaker imagined that in congested street areas where pipes, &c., had unavoidably to pass through the manhole, concrete construction would be more expensive than brick owing to difficulties with the shuttering. The practice of providing that entry was made in the centre of the manhole in all cases was excellent, and the provision of a ladder seemed to be of primary importance. The installation of racks during manhole construction was also an important point, as it was imperative that the cabling gang should have means of supporting the ends of the cable after drawing-in, to avoid kinking at the duct mouth.

Progress in drawing-in must undoubtedly be expedited by the adoption of standard manhole construction, and he had always been of the opinion that a manilla rope was unsuitable for drawing-in purposes owing to the fact that the rope stretched to a great extent before the cable moved, and when the latter did move the cable entered the duct with a rush, thus causing a danger of the cable being kinked and damaged at the feeding end.

That any lubricant used acted as a lubricant only, and did not form an effective preservative against chemical or electrical action on the lead sheath seemed probable in view of the fact that much of the lubricant must be scraped off the sheathing at various points during drawing-in operations. Regarding the statement that four miles of full-sized cable was drawn-in in one day by a gang of twenty men working for ten hours; it seemed to be a remarkably small time allowance for all the operations, and the question naturally suggested itself: How many motor winches were used? Also whether the operations covered a distance of four miles from point to point, or whether several cables were drawn-in at one position, thus doing away with the necessity of moving the motor winch after every two pulls? The figures given for speed of jointing were indeed remarkable, and it seemed especially imperative that underground balanced-trunk lines should be air-pressure tested, as should it be found necessary to withdraw a length owing to faulty plumbing or sheathing much time and expense would be involved in breaking up the loading coil section to balance in the new length. He was also surprised to note that no attempt was made to remedy low insulation by means of desiccating, as there was no doubt that very good results could be obtained if desiccation was properly carried out. A disadvantage of waxing joints was that the colours of the marking papers were to a large extent neutralised by waxing. When jointing a balanced trunk cable according to a prearranged selection scheme that might lead to serious errors, especially when working in a manhole in artificial light. The speed of 50 ft. per minute for drawing-in cable could be quite safely used provided the cable could be suitably lubricated. The paper contained many points of importance which could be profitably adopted in this country.

MR. J. A. MORTON thought that one reason for the great development of the telephone industry in the United States was that, generally speaking, the construction there was not so substantial as it was in the British Isles—the Americans were willing to take more risks and to experiment more frequently, and thus got a cheaper construction, and so a cheaper service. Americans would also run a line out of their way for one or two customers, knowing that if the poles were once there a demand usually followed from others, as it did in the case of an electricity supply main—once put the main down and the customers would come along. A percentage of tin or antimony in the sheath of both aerial and underground cables strengthened the lead, but it did not help against chemical action. A lead sheath with 3 per cent. of tin in it was 50 per cent. stronger than a pure-lead sheath, and, seeing that telephone cables had not much lateral strength, for that reason the Americans were quite right in using the tin both for underground and for overhead cables. In this country the Post Office used no tin in underground lead sheaths; possibly it was not thought worth the extra money.

That untreated cedar poles had a life of nineteen years seemed rather a long time, though by creosoting under pressure that life might easily be doubled. There seemed to be no general rule in America as regarded the factor of safety of the poles. The cost of pole roofs was very small, and it would add to the life of the pole. All the fancy stay "gadgets" were interesting, but after all was said and done nothing beat the old "dead man" (usually and fittingly part of a defunct railway sleeper), and all the patent earth-boring anchors required soil reasonably free from large stones, otherwise one could not get them in. He doubted if they were as strong as a "dead man" when they were in.

Wooden insulator pins would not last nearly so long as galvanised steel. In that connection a lapping of jute string at the bottom of the threads on iron pins would stop jarring. He thought that glass insulators developed internal disruptive stresses under temperature changes and were very unreliable, but apparently that difficulty had been got over in America. The photograph of the 2,000-volt power line with the delightfully simple so-called guard arm underneath and just above the telephone wires might make some people feel safe, but the speaker would not care to use that telephone wire when the power wires had been brought down by a storm.

The vibration method of finding the dips was like finding the tension on a fiddle string by its note—or counting the number of its vibrations, if that could be done. Single cable rings would grip the wire, and would not move about in a wind, but it seemed like setting a cable on a knife edge, especially when that cable weighed from 4 to 8 lb. per foot.

If the statement that there was a saving on the annual cost of aerial cable meant a saving in maintenance costs he could not agree, nor did he care for the idea of creosoted wooden ducts, as they absorbed moisture, and it was essential that the creosote oil be absolutely neutral or there might be trouble with the lead.

MR. W. HOLTTUM said that the upkeep expenses of aerial cables were less than for underground ones, which seemed contrary to what one would expect. The description of the crank handle method of jointing was interesting, and it was not apparent why it should not be adopted in this country.

MR. W. COWBURN thought that the methods of construction adopted in this country would bear favourable comparison with those in the States, where the industry had been left open to competitive commercial enterprise. On the other hand, in England they should have the advantages accruing from one ownership. With regard to the question of organisation, there appeared to be no engineer-in-chief, which meant that the ultimate decision as regarded technical matters rested with an individual who was not necessarily an engineer. It would appear that the scope for the use of 3½ lb. conductors in this country would be very limited. Aerial cables would never be used so extensively in England as in the States; it was much more likely that cheaper methods of construction would be looked for on the lines of protected cable. Where any metal came into contact with the lead sheath damage would be done to an aerial cable, and had not Mr. Byng pointed out the extensive use to which the Bonita and Blackburn steel suspension rings were used in the States the speaker would personally have hesitated to use them.

SMOKE ABATEMENT.

REPORT OF MINISTRY OF HEALTH COMMITTEE.

THE Committee appointed in January, 1920, by the Minister of Health, to "consider the present state of the law with regard to the pollution of the air by smoke and other noxious vapours, and its administration, and to advise what steps are desirable and practicable with a view to diminishing the evils still arising from such pollution," has published its final report (H.M. Stationery Office. Price 6d. net).

The opening sections of the report give a concise review of legislation enacted to diminish the amount of smoke from industrial establishments and the powers given to local authorities in this matter. The regulations in force in London are set out separately, and it is noted that under one of its Acts the L.C.C. is empowered to expend a sum of £500 annually in making experiments and investigations with respect to smoke consumption and abatement. The restrictions placed upon railway and road-locomotive companies are touched upon, and particulars of a number of local acts dealing with the subject of smoke nuisance are given. Conditions in Scotland and in certain foreign countries are discussed briefly. Section V deals with the waste and damage due to smoke. It is estimated that the potential fuel annually discharged into the atmosphere in the form of soot amounts to 2½ million tons from domestic fireplaces and to 500,000 tons from industrial establishments. (These figures refer, presumably, to this country alone.) At £2 per ton this represents an annual and direct waste of £6,000,000. It is shown in the report how injurious to health and buildings this pollution is, and the fact that a great deal of material detrimental to health is discharged is proved by the mean monthly deposits of solid matter per square mile in Birmingham and London, which are 54.2 and 25.4 tons respectively. In Section VI the use of raw coal in domestic establishments is condemned as a wasteful, dirty, and unscientific process, and its substitution by superior methods is touched upon. For large buildings such as hotels, clubs, and blocks of offices, the best system is said to be some form of central heating arrangement with supplementary heating by gas or electric fires. The Committee, therefore recommends that local authorities should be empowered to frame by-laws enforcing the provision of smokeless heating arrangements in new buildings other than private dwelling houses. With regard to electricity, it is stated that "from a hygienic and labour-saving point of view, electric cooking and heating has much to recommend it, and the Committee hopes that the prices at present charged in many localities will be reduced to such a point as to allow of a considerable extension of its use." The report also says that gas for cooking and heating also has many advantages over a coal fire, and the use of gas coke for central heating and for open grates is recommended. Low temperature carbonisation forms the subject of Section VII. The general conclusions of the Director of Fuel Research during an inspection of an installation at Barnsley (described

in our issue of November 18th, 1921, p. 664) are set forth. It is said that until the engineering, technical, and economic aspects have been further tested and developed, it will not be possible to determine how far this particular method will contribute to the solution of the national problem of the proper utilisation of coal. In Section VIII industrial smoke is considered under two heads:—Smoke from boiler furnaces; and smoke from other manufacturing processes. Regarding the former it is shown that, under normal conditions and with careful stoking, little or no smoke need be produced, and that in many cases it would be practicable without undue expenditure to reduce considerably the amount of smoke already emitted. Special classes of instruction for stokers are recommended. An absolute prohibition of the emission of smoke from certain other processes is considered impracticable, and the law should be altered so as to provide that manufacturers should take all practicable steps to reduce pollution of the atmosphere; absolute prohibition if properly enforced would be likely to destroy some industries. Among other suggestions made are that a standard enabling an authority to define a nuisance should be fixed; and that the emission of "grit" should also be a punishable offence. The difficulty of proving a smoke nuisance case is illustrated by the "Lots Road case" in which the Chelsea Borough Council prosecuted the Underground Electric Railways Co. The prosecutors in this case failed to convince the magistrate that the smoke from the power station was scientifically "black." Such cases deter local authorities from taking action, and the fines at present imposed are also too trivial to act as a deterrent. It is suggested that more uniform practice should be established and that administration of the law in this respect should be in the hands of County Councils and the Councils of County Boroughs. The Minister of Health, it is considered, should appoint one or more competent officers to advise and assist both local authorities and manufacturers with regard to smoke problems. In connection with noxious vapours it is reported that, while nuisances from chemical works are not unknown, the Alkali, &c., Works Regulations Act, 1906, appears to be adequate. In its general conclusions the Committee recommends a stricter supervision of local authorities by the Ministry of Health with regard to smoke and noxious vapours; defaulting authorities should be compelled to act in cases of serious pollution of the atmosphere. A number of Appendices follow the report. Appendix A, on smoke abatement in Germany, says that while conditions generally are better there than in this country it is because the great development of industry is of comparatively recent growth. Appendix B reproduces the Committee's Interim Report which was briefly reviewed in a note on p. 898 of our issue of December 30th.

CORRESPONDENCE.

Letters received by us after 5 p.m. on TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

High-Pressure Fuses.

With reference to the article on "High-Pressure Fuses" appearing in your issue of November 25th, and a letter by Mr. J. B. Rudkin on December 30th, your contributor has raised several points of general interest.

Mr. Rudkin points out the possibility of only one fuse blowing in a three-phase circuit, thus leaving the circuit of the other phases complete, with consequent danger to the motors. We would point out that the "Empire" S. & C. high-tension fuse is not intended to open a circuit on ordinary overload, but is specially designed and constructed to protect the line and apparatus from short circuits. Under the conditions of a short circuit, it is practically certain that the excessive rush of current will blow two or all three fuses. If, on the other hand, the current gradually increased, the oil switch used with the fuse would trip and open the three phases, and if it should happen by a combination of circumstances that the fuse in one phase only should blow, then the overloads in the remaining phases would be sufficient to open the switch.

This point is only of interest, of course, so far as three-phase circuits are concerned. In single-phase circuits, such as potential transformers, &c., the condition referred to cannot occur.

With regard to the opening of high-tension lines on short circuits where a large amount of power is available, the oil circuit breakers often give trouble and sometimes even fail completely.

The "Empire" S. & C. fuse is more rapid in its action than the quickest-acting oil switch, and this rapidity of operation reduces the explosive effect, which is still further reduced, due to the lessened possibility of vaporisation and ionisation inside the fuse.

From the last point raised by Mr. Rudkin, regarding the use of carbon-tetrachloride, it appears that he is not clear about the construction of the fuse. The fuse is completely sealed so that no liquid or vapour escapes under ordinary running conditions, and even when the fuse is blowing very little liquid is spilt.

The trouble involved in cleaning any contacts after a short circuit is negligible.

J. M. Scott-Maxwell,
Managing Director
Electric Control, Ltd.

Glasgow.
January 10th, 1922.

A Message from Mars?

I think that if "S.O.S.," St. Annes, will investigate his "messages" he will find they are due to a condition of resonant vibration in his pipes, caused by one or more partial airlocks in the pipes concerned. If this is so, it can be stopped by opening a tap for a minute and closing it slowly and without shock.

A leaky ball-valve can also produce this same effect, particularly if the lever is long and springy.

Another Sufferer.

Rawtenstall.
January 10th, 1922.

I was very interested in the letters appearing under the above heading in your last two issues, as I had a very similar experience to "S.O.S." about a couple of months ago.

I happened to be staying in Oxfordshire for a couple of days, and in the early hours of the morning, between 2 a.m. and 3 a.m., whilst lying in bed, could distinctly hear sounds, very similar to the sounds heard in the telephones of a wireless receiving set. There was the same slightly musical note that is peculiar to some transmitting stations. These sounds were not audible in all parts of the room, but only by lying in bed with one's ear to the pillow. The wire mattress seemed to be acting as a receiver. The sounds lasted about half an hour, and the same thing was repeated on the second night of my visit.

The house is a small one in a quiet neighbourhood, without hot water or electric light. I was so confident that these were wireless signals that I intended investigating the matter thoroughly, but unfortunately had to leave before I had a chance to do so.

Perhaps one of your wireless readers will enlighten one who is seeking for information.

Inductance.

January 14th, 1922.

High-frequency Stray Sparks on Motor-cars.

With reference to the article by "Voltman" in your issue of December 30th, 1921, it may be of interest to him and to your readers to know that I had conclusive proof of high-frequency effects from motor cars as far back as 1913.

I was using a small wireless installation situated at the back of a house, and while listening with head-gear telephones I heard a faint humming sound which grew gradually louder until it reached a maximum, and then it began to fade away. Wondering what it could be I removed the telephones, and then could plainly hear the sound of a motor-car engine as it passed away in the distance. Since that time I have on several occasions heard a similar effect, and being prepared have verified the maximum intensity point as the car passed the house. I have noticed many cars that do not give this high-frequency oscillation, or if they do, it is quite inappreciable, being too small to affect the receiver, even when the car is quite close, whilst others are most marked, giving quite a loud note when close, and affect the wireless receiver when about 400 yards distant.

The receiver although not a valve is a rather sensitive one, as it can be made to respond readily to the ringing of ordinary electric bells in neighbouring houses. The postman provides a ready means of calibration.

Night Watcher.

London.
January 12th, 1922.

Mysterious Phenomena.

With reference to "Ginger Beer's" letter in the ELECTRICAL REVIEW, of January 6th, I should like to mention that I have come across a similar instance of a person getting a shock from a water tap to earth.

I am of the same opinion as the editor, that is, that it is due to the fact that the resistance of the water pipe is lower than that of earth.

But it seems rather remarkable that the potential difference is sufficient to give a person a shock when, as in my case, the original potential difference was only 105 volts to earth.

I have recently come across a paragraph in an old pocket book which gives particulars of an experiment carried out, where bare conductors were submerged in a canal for about a quarter of a mile and an electric current was passed through them, working a telegraph instrument which proves that although a bare conductor is surrounded by earth, it need not drop to earth's potential.

I am inclined to think that the sounds in the telephones are due to the close proximity of conductors, which would induce a current in the 'phones on the telephone circuit being closed by earthing the two leads.

Interested.

Bristol,
January 9th, 1922.

Single and Polyphase Commutator Motors.

With reference to your notes in last week's issue of the Electrical Review *re* above, it might interest you to know that we have actually installed at these works two 18-h.p., 400-volt, 50-cycle, 3-phase, a.c. commutator motors, with shunt characteristics, for driving two rotary " web " presses.

The motor is capable of giving a speed range of 375/1,500 r.p.m. by hand-wheel control, the torque being constant at any speed, in addition to which, push-button stations are fitted at various positions on the presses for " Starting," " Inching," and " Stopping."

We believe these two machines are the first of their kind installed and running under working conditions in this country, at any rate for this class of work.

W. T. Kenney.

London, *Newnes & Pearson Printing Co., Ltd.*
January 16th, 1922.

A Mountain—or a Mole-hill?

I must say that your article " Killing the Goose " in the Review for January 13th is a most amusing and well-written sketch, but surely it is not meant to be more than that. Really, I hope the writer does not expect or wish us to believe that most of the famous houses in the electrical trade are in essence liars, thieves, and breakers of agreements, to say nothing of falsifiers of books. These things are very easily said, but to prove them is a very different matter. The manner in which your contributor writes is almost a direct incentive to every firm to break the lamp agreement, and I refuse to believe that such a low type of morality is common to our trade. I know for a fact that there are *some* houses that would not stoop to such dirty work, for, no matter how amusingly you refer to it—no doubt to salve your conscience—that is what it is, and no man can lay claim to be an honest business man who depends upon such tricks for his trade.

I sincerely hope the Lamp Association will have a reply to give to your contributor's article vindicating the honour of their signatories.

Signaller.

January 17th, 1922.

[Our correspondent certainly knows a humorous article when he sees it; but, having detected its humour, why does he treat it so seriously? A spice of exaggeration is one of the most usual ingredients of humour.—Eds. Elec. Rev.]

Revenue from Power Supply at Lighting Rates.

With reference to the letter in last week's issue of the Electrical Review, by Mr. H. Challis-Sowerby, I should like an opportunity for making a few observations thereon.

The statement is made that 50 per cent. of the consumers in the Manchester district represent works and small shopkeepers and therefore are ruled out of the argument. That is hardly correct. Why rule them out? Surely in some of these works and shops a small electric fire would be welcome for use during the severe winter time for just, say, an hour or so in the early morning or evening, or a small electric kettle for making a cup of tea, &c.: and these, if offered on the hire-maintenance system, would afford a real blessing to the consumers during those short intervals, and not all would feel inclined to go to the expense of running a special power circuit when the time such apparatus would be in use is so short. Many will pay a shilling or two per month at certain periods for hire of the articles, and be pleased to pay for a few units so used at lighting rate for the comfort, convenience, and benefit of a little bright heat, or a quickly made cup of tea or cocoa at just those times when it is greatly appreciated.

And again, 30 per cent. of the consumers are poor persons. Yes, and provided the scheme is properly explained and demonstrated, my experience says that those poor persons are the first to realise the benefit and handiness of an electric iron for a couple of hours per week, or a rapid toaster which can be brought into use at a moment's notice—when both may be obtained for use whenever necessary on hire-maintenance at about 6d. per week.

Also, that remaining 20 per cent. would surely be interested in one or more of the numerous small electricity-consuming devices now available.

I do not suggest that any consumer would entertain the idea of a number of these appliances being used off the lighting circuit, but I am certain some do, and others would, welcome electric radiant fires in bedrooms for a few minutes' use night and morning during the cold weather, and pay for them at lighting rates to ensure such comfortable conditions, knowing full well that the whole expense can be cut out directly better weather sets in. Similar remarks may be applied to other apparatus, such as small hot-plates, curling tongs and shaving-water heaters, fans, &c. Once the consumer realises that for a couple of shillings the apparatus is his—or hers—for a month to use whenever the necessity arises, and that there is no fear of other charges for repair and maintenance, merely one penny for energy each 15 minutes it is in use—that consumer will want more.

There is in every house or shop where electricity is available a demand for some form of electricity-consuming device, and a properly advertised and demonstrated scheme for the hire-maintenance of these goods would show the existence of such demand.

No consumer thinking of using several heaters, cookers, &c., would dream of paying lighting rates, but it is the large number who at present do not make use of any who would be pleased to pay a little extra for the great convenience and comfort derived at seasonable times from the use of such small apparatus without going to the expense and trouble of a separate circuit and meter.

Interested.

January 16th, 1922.

Change-over from D.C. to A.C. Supply.

It will be useful if some of your readers can give an opinion on the following problem, which doubtless will affect many stations.

A length of distributor 800 yards over ground consists of three single conductors, each conductor being paper-insulated and lead-covered. The cables are laid solid in troughing. As they are rather cramped they touch each other at intervals, and are also bonded together. The current in the cables is 140 amperes in the outers at the near end, falling to half this amount at the far end. The current in the neutral is, of course, small.

It is proposed to change the supply over from d.c. to single-phase a.c., 480 volts on the outers, 40 periods. The problem is; will there be trouble owing to currents induced in the lead coverings? One might expect that induced currents would cause heating of the lead coverings, and that there might also be difficulty owing to loss of voltage in the conductors themselves.

Any information that can be given by readers will be gratefully received by

Mains.

Tynemouth Corporation Electricity Dept.
January 16th, 1922.

Commutator Notching Machines.

In your current issue there appears a description of a commutator notching machine for cutting down the mica insulating strips below the surface of the commutator bars. You state that the machine weighs about 23 cwt., that it has a long bed for supporting the armature, and that it can deal with commutators from 11 in. to 17 in. in diameter and 12 in. long.

Your readers may be interested to know that, at the request of several leading electrical engineers, we have been for several years working at designing and perfecting a machine for this purpose, and that we have succeeded in producing an apparatus that has been tried at an important generating station, where a large commutator has been notched to the complete satisfaction of the electrical engineer.

Our machine weighs only a few pounds, it can be driven by hand power or flexible shaft, it will notch commutators up to the largest diameter and any length of face and will cut the grooves whilst the commutator is in position. It can be carried to the commutator, so there is no need to take out the armature. It can be easily adjusted for bars of different widths, or grooves of different depths, and can be furnished with cutters of varying thicknesses. The whole apparatus, including gearing on portable stand and flexible shaft, weighs only about 28 lb. The machine is patented.

John Phillips & Co.

London,
January 17th, 1922.

English Books for Latvia.—The Lord Mayor of London tenders his thanks to all who kindly responded to his recent appeal for English books for Latvia. The announcement of the shipment to Riga of several thousands of books (forming the first instalment of the New Year gift of 50,000 volumes which the Lord Mayor hopes, with the further help of the public, to get together) has been received with the liveliest satisfaction in the newly-founded Baltic State, which has decided to adopt English as its second language, and is anxious to assimilate English ideals, particularly in education. Latvia, it may be recalled, successfully resisted the Bolshevism which at one time threatened to overwhelm the country, and, if only for that reason, is deserving of such sympathy and help as can now be extended to it in a way which the practical scheme set on foot by the Lord Mayor makes possible. Further contributions of English books are solicited. Parcels should be addressed (carriage paid, if possible) to Sir Alfred T. Davies, K.B.E., C.B., c/o the Consul-General for Latvia, 329, High Holborn, London, W.C.1.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

A New Connector Plug for the "Xcel" Iron

A certain amount of trouble, which militates against the extended use of electric irons (and other appliances) is caused by the fracture or stripping of connecting leads by users taking the connector out by pulling on the flexible. To do away with this the Automatic Telephone Manufacturing Co., Ltd., Milton Road, Edge Lane, Liverpool, is now fitting

Fig. 1.—The "Xcel" Iron, showing new Plug Connector.

its "Xcel" irons with a new type of plug connector. As will be seen from this illustration (fig. 1), the leads are brought into the side of this instead of the top, and the shape permits it to be gripped by the hand when being removed. This is a simple device, but one which will prevent annoyance to the users of electric irons.

The Bowden-Thompson Cable Protection System.

From the Macintosh Cable Co., Ltd., Rice Lane, Walton, Liverpool, we have received a booklet giving particulars of the Bowden-Thompson system for protecting cables against the detrimental effects of earths and short-circuits. As will be seen from fig. 2, the cable employed is a special one made up with a copper sheathing outside the conductors and a copper shield between them. Reference to fig. 3 will enable the arrangement of the system to be understood. This dia-

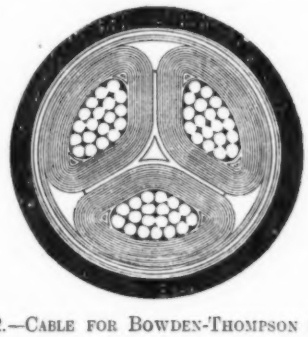


Fig. 2.—Cable for Bowden-Thompson System.

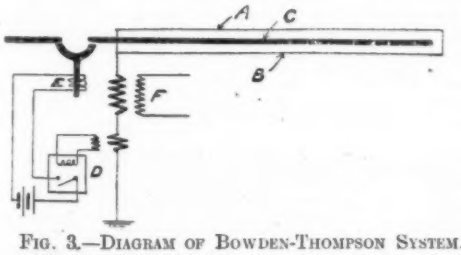


Fig. 3.—Diagram of Bowden-Thompson System.

gram shows the cable switched from one end only; in the case of parallel feeders and ring mains both ends would be treated in the same way. A is the metallic shield between the cores, B the shield between the cores and the lead sheathing, and C the main conductors. If any leakage occurs from any of the main cores to A or B it is directed through relay D to earth, and the relay operates the main switch by the trip coil E. If the cable is extremely damaged, shield B is earthed before the main cores are reached, and as this shield is maintained by transformer F at a different potential to earth, a current will flow through the relay and open the main switch.

Among the numerous advantages claimed for this system the following may be mentioned: It isolates the faulty cable before the main conductors short-circuit or break down to earth; it provides protection between phases as well as against earths; it is independent of pressure and load variations; there is no tendency to switch out sound feeders which are in parallel with a faulty one; specially-designed switchgear is not required; the system is suitable for both d.c. and a.c. mains; absence of outside arcing; and the indication of the slightest faults as soon as they occur.

The Astral Intensifier.

We have received a sample of a new form of lamp reflector from The Astral Intensifier, Ltd., 56-7, Carlton House, 11a, Regent Street, S.W.1. This has the shape of the usual lamp shade but is made to fit upon the lamp itself. The reflector is of soft, light metal, with an inner reflecting surface of aluminium paint. A hole in the top is surrounded by easily bent serrations which enable the reflector to be fitted to a wide range of sizes. Its correct position over the lamp is with the top level with the top of the filament. It is claimed that tests at Faraday House showed the intensity of the light at a point vertically below was increased to 34½ times that of the naked lamp.

An Electrical Gas-Lighter.

A few weeks ago we warned our readers (if warning was necessary) against a device produced by a German for lighting a gas jet by means of an electric spark, an earth return being provided by the piping. A more practical invention for this purpose has been brought out by Messrs. Lord & Shand, Ltd., Buckland House, Millbay, Plymouth. This is intended principally for the lighting of gas fires in places where electric lighting is installed. It consists of a double lead in one side of which is a condenser. A sparking tip completes the arrangement. The lighter is supplied with an adaptor, which can be attached to a lamp socket. The device will not afford a very valuable "load" to the electricity suppliers, as the makers inform us that its consumption in watts is *nil*. The lighter is made suitable for connection to circuits of from 100 to 250 V a.c.

The "Holophane" Colour-matching Lamp.

Messrs. Holophane, Ltd., 12, Carteret Street, S.W.1, have produced a "daylight" lamp for matching colours with artificial light. As will be seen from fig. 4, this consists of a Holophane prismatic reflector held by a ventilated canopy, and a "diaphragm" of Chance's daylight glass attached to the re-

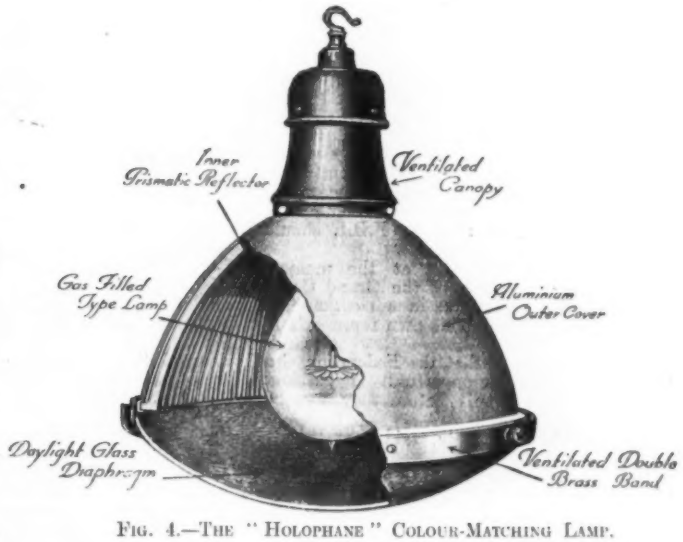


Fig. 4.—The "Holophane" Colour-Matching Lamp.

flector by means of a ventilated brass clamping ring; a gas-filled lamp is employed. Although the method employed, viz., the absorption of surplus red and yellow rays, is of low efficiency— only about 40 per cent. of the light from the lamp passing through the daylight screen, the use of the Holophane prismatic reflector ensures that most of the light reaches the screen, and thus a comparatively high efficiency is obtained.

THE ELECTRICAL INDUSTRY AND GERMAN REPARATIONS.

At a meeting of the Grand Council of the Federation of British Industries, held on January 11th, there was an important discussion on the above subject. We reprint the following report from the Federation *Bulletin* of the 17th inst.:—

Before opening the discussion on the Memorandum on Reparation Payments and British Trade, which had been circulated, the President drew attention to the fact that the Electrical Engineering Group had been much perturbed at the widely published personal suggestion of the late President made at the meeting held at the close of the annual meeting, on the subject of super-power stations. The Group had met, and in view of the feelings expressed he had felt it desirable to write to the Chancellor of the Exchequer making it quite clear that the suggestion was a private one and did not form part of the policy of the Federation. Col. Armstrong (President) read this letter to the Council and also the following resolution passed by the Group, which had been enclosed with the letter:—

"That this Committee, representing the Electrical Engineering Group of the F.B.I., desire to emphatically register their strong protest against the suggestion that super-power stations for the wide-spread supply of electrical energy throughout the country, and the electrification of British railways, should be placed in the hands of German manufacturers, and accepted by the Government in lieu of cash payments as part of the German reparations. The Committee record their conviction that such proposals, if accepted, would mean the inevitable ruin of the British electrical industry, and lead to the closing of important factories, the discharging of technical staffs and large numbers of skilled and unskilled workpeople. Such action would further be used as a world-wide advertisement of German electrical goods, and thus gravely damage the British export trade in such goods to overseas markets."

A copy of the letter and the resolution had been sent to the Prime Minister, and the President hoped that the position had now been made quite clear.

Sir Tom Callender, Chairman of the Electrical Engineering Group, agreed with the action taken. The statement in question, he said, had had an unfortunate effect in the case of foreign contracts, and if the need arose the electrical industry would apply to the Federation for further assistance in clearing up the position, but he did not wish to press the matter further at the moment.

Mr. Dunlop (B.E.A.M.A.) and Mr. Bremner (B.E.A.) stated that in view of the statement made by Sir Tom Callender, they had no desire to press the points which their Associations had desired to express.

The President assured Sir Tom Callender that the Federation would gladly render the electrical industry all possible help in making the position clear.

Col. Armstrong then introduced the general subject of reparation payments and the trade situation, dealt with in the Memorandum before the Council. He said that neither the officials of the Federation nor himself were in a position to reply if asked (as they might be without warning) what the views of the F.B.I. were on these important questions. He therefore suggested that the Council should indicate its attitude towards the points outlined in the Memorandum.

Mr. H. James Yates urged that the Federation should move cautiously and should refrain from passing any resolution at present. Mr. Allcock supported this view.

The Director reminded the Council that these questions had been under consideration for several months. In view of the fact that, if asked to express an opinion at all, the Federation's representatives would have to speak at very short notice, it was necessary that a definite line of action should be laid down by the Grand Council one way or another.

Mr. Calder agreed that the F.B.I. should be prepared to give its views at short notice.

The President said that at the moment he was not in possession of the views of the Grand Council. He felt that unless the Federation was in a position to speak, the Prime Minister would appoint his own representatives to express the opinion of industry.

Mr. Allcock urged that the Federation should demand that industry be given the opportunity of passing judgment on the Government's proposals before they were definitely decided upon.

The President, in reply, said that this was already being pressed for.

Mr. Bremner thought that the Federation should at once claim to be represented at Cannes. Sir William Pearce, M.P., did not think this would be practicable; he was in favour of the officials of the Federation being empowered to act in any consultation with the Government.

Mr. Dunlop was of opinion that the Government should be urged to consult the President of the F.B.I.

Mr. P. M. Stewart then formally proposed that the President should be asked to represent the F.B.I., assisted by the staff and with power to act as he thought best, consulting any industry affected if it was possible to do so. This was seconded by Mr. Calder, supported by Mr. Jacob and Mr. Bremner, and unanimously agreed to. It was further agreed that a letter should be sent to the Prime Minister requesting him to appoint the President as one of the industrial representatives at any future conference.

LEGAL.

British Thomson-Houston and Corona Litigation.

In the Chancery Division, on Thursday last week, before Mr. Justice Astbury, Sir D. Kerly again mentioned the patent case of the British Thomson-Houston Co., Ltd., against the Corona Lamp Works, Ltd., and asked his Lordship to fix February 6th for the hearing of the action.

Sir A. Colefax, K.C., for the plaintiffs, assented.

His Lordship accordingly fixed that day, subject to any part-heard case.

Cheshire *v.* Jones and Studebaker.

At the Chester County Court last week, Messrs. Cheshire Bros., of Higher Bebington, sued Messrs. F. J. Jones & Sons, electrical engineers, of Forest Street, Chester, and Messrs. Studebaker, London (cited as defendants), for £39 3s. 6d.

For the plaintiffs, it was stated that they received an inquiry for a "Lalley" lighting set from Monmouthshire, and the defendant firm was given the order. Subsequently an advice note was received from Messrs. Studebaker, from which it was known that the erection of the plant had been completed. Complaints were afterwards made of the engine stopping, and Mr. Jones suggested certain tests and alterations, and that he should supply a new diaphragm. After the alterations had been effected, the trouble still existed. Later Mr. Jones admitted the plant was defective.

The manager for Messrs. Jones & Sons said he was an electrician of 28 years' experience, and his firm had been selling agents for Studebaker's for over two years. He denied that the plant was defective when delivered. Another witness said the plant had been badly erected, and the vibration was causing trouble.

Mr. Marshall Tate, manager of the "Lalley light" department of Studebaker's, said the machines were tested in America and in England before being sent out. He did not think there was any responsibility on the firm to put the plant right.

His Honour, Judge Parsons, K.C., found for the plaintiffs as against Messrs. Jones for the amount claimed, and granted an indemnity in favour of Messrs. Jones, as against Messrs. Studebaker, Ltd., for the amount payable by Messrs. Jones, with costs.

Partnership Dispute.

A dispute between two partners of an electrical firm has been decided by the Sheriff Principal at Perth. The parties were Donald Mackenzie, electrical engineer, and William Wilkie, partners in the firm of Donald R. Mackenzie & Co., electrical engineers, 91, South Street. Mackenzie stated that he wanted to see the books of the firm, which were kept in Wilkie's house. He craved the Court to order Wilkie to produce the accounts so that the true balance due to him might be ascertained. Failing this, he asked for the payment of £175 which he alleged was the balance due to him. Defender maintained that Mackenzie had free access to the books. The Sheriff Substitute had dismissed the action, finding Mackenzie liable in expenses. The Sheriff Principal recalled the interlocutor of the Sheriff Substitute, and found Wilkie liable in expenses to the pursuer.

Britannia Rubber & Kamptulicon Co., Ltd., *v.* International Electric Co., Ltd.

In the King's Bench Division, on Monday, before Mr. Justice Avory, sitting without a jury, this case was down for hearing, but on the case being called on Mr. Disturnal, K.C., for the plaintiffs, asked that Mr. Schiller, K.C., for the defendants and himself might be permitted to have a few minutes to discuss the case with their respective clients. After a brief consultation, counsel stated that the defendants were willing to pay the plaintiffs £1,438 16s. 6d. with the costs of the action and a counterclaim.

Battery Charging Pays the Shop Lighting Bill.—The New London Motor & Cycle Works, of 47, Plashet Road, East Ham, which does a large business in re-charging accumulators for motor-cyclists and car-owners, has so arranged the work that by charging the batteries in the late afternoon and evening, and utilising the shoplights as the necessary voltage stepping-down medium of the current taken from the local electricity supply mains, the revenue from the battery-charging business practically pays the shop lighting bill. The installation comprises a dozen 100-c.p. gasfilled lamps, and the proprietor of the establishment makes a rule of keeping his shop windows lit for an hour or so after the premises are closed, and finds the plan to be a good advertisement for the business.

BUSINESS NOTES.

The "Electrical Review" Index.—The Index to Vol. LXXXIX of the ELECTRICAL REVIEW, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To them it will be supplied for 6d. post free. Any reader or advertiser, at home or abroad, who requires a copy for binding, or for other purposes, is asked to make early application therefor to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, E.C.4.

Bankruptcy Proceedings.—W. HURWORTH, electrical engineer, late of 41 Town Street, Horsforth, Leeds.—Receiving order made January 11th on creditor's petition.

W. DRYSDALE, electrician, 24, Paxton Street, Barrow-in-Furness.—Last day for proofs for dividend, February 4th. Trustee: Mr. H. Mossop, 4, Ramsden Square, Barrow-in-Furness.

P. ROTHWELL, electrical engineer (trading with P. A. Rothwell, a minor, as P. A. Rothwell & Co.), 64, Higher Bridge Street, Bolton.—Receiving order made January 12th on debtor's own petition.

E. FAWCETT, electrical and heating engineer, 20, St. Anne Street, Liverpool.—Receiving order made January 13th on debtor's own petition.

E. G. LANGSFORD, electrician, late of 74, Westgate, Burnley.—First meeting, January 25th, at 13, Winckley Street, Preston; public examination, January 26th, at Burnley.

Company Liquidation.—ENAMELLED WIRES, LTD.—Winding up voluntarily. Liquidator: Mr. E. Vickers, 13, Harrington Street, Liverpool.

Dissolutions of Partnership.—COLLINS & SLATER, agents for Electrical Appliances, 17a, Sweeting Street, Liverpool.—Messrs. S. Collins and W. O. Slater have dissolved partnership. Mr. Collins will attend to debts.

PRINCESS ELECTRICAL CO., electrical accessory dealers, 29, Minshull Street, Manchester.—Mr. S. B. Sukiassian and Mr. J. H. Taylor have dissolved partnership. Debts will be attended to by Mr. Sukiassian, who will continue the business under the same name and at the same address.

SHALLESS & STRETCH, electrical and mechanical engineers, 192, Bedford Road, Rock Ferry, Chester.—Mr. A. H. Shalless and Mr. A. Stretch have dissolved partnership. Debts will be attended to by Mr. Shalless, who will continue the business at the same address. Mr. Stretch will carry on the business on his own behalf at Birkenhead.

Trade Announcements.—MR. THOMAS TWIST, late of the Corporation Electricity Works, has commenced business as an electrical engineer, under the style of Twist & Son, at Britannia Chambers, George Street, St. Helens.

The telephone numbers of the BRITISH THOMSON-HOUSTON Co.'s Liverpool office (33, James Street), are now "Bank 4374 and 4375."

MR. LIONEL ROBINSON, B.A., has taken into partnership MR. W. E. WARRILOW, A.M.I.E.E., as and from January 1st, and under the name of Lionel Robinson & Co., will continue and further develop, at 3, Staple Inn, London, W.C.1, the sole agency for resistance materials and wires of Messrs. Henry Wiggin & Co., Ltd., Birmingham, which he has held for the past 15 years. Mr. Lionel Robinson is the originator with Messrs. Henry Wiggin & Co. of their "Ferry" resistance wire, and Mr. Warrilow has had 15 years' experience of commercial work, chiefly in encouraging, through the Press, the sales of electrical and allied products of every description. Makers of electric fires and cooking apparatus will be interested to know that the firm is now introducing for Messrs. Wiggin two grades of iron-free nickel chrome alloys in wire and ribbon form. They will also develop other agencies for any class of material required by manufacturers using electrical resistance alloys.

Following upon a notice which appeared under "New Companies Registered," a few weeks ago, it is announced that the business hitherto carried on by the British, Irish, and Colonial department of the Ateliers de Construction Oerlikon, has been transferred to Oerlikon, Ltd., Oswaldestre House, Norfolk Street, Strand. The company represents the Ateliers de Construction Oerlikon in Oerlikon (Switzerland), and the Société Oerlikon in Paris (France), with works in Oerlikon (Switzerland) and Ornans (France), exclusively in Great Britain and the Colonies.

Catalogues and Lists.—THE HOTPOINT ELECTRIC APPLIANCE CO., LTD., 21, Berners Street, Oxford Street, W.1.—An illustrated pamphlet dealing with "Hotpoint" ovens, radiators, disk stoves, and immersion heaters.

THE ELECTRIC HEATING CO., George Street, Croydon.—A list of reduced prices of "Elect" irons; and an illustrated leaflet describing an electric soldering-iron stove.

SIMPLEX CONDUITS, LTD., Garrison Lane, Birmingham.—Section T. List No. 915. An abridged price list of conduit fittings, switches, plugs and sockets, &c. Attention is drawn to a special cardboard cap for the protection of the screw threads.

SUPERLAMP, LTD., 111, Great Eastern Street, E.C.2.—January price list of cables, flexibles, ceiling roses, lampholders, switches, and other electrical accessories.

MESSRS. PHILLIPS & TURNER, 115, Edmund Street, Birmingham.—Three illustrated leaflets of lighting fittings, including bowl rings, ceiling plates, &c.

THE HENRY WELLS OIL CO., 11, Haymarket, S.W.1.—Revised edition of a pamphlet upon "Germ Process Motoils" for the lubrication of machinery.

FRASER & CHALMERS ENGINEERING WORKS (Proprietors: The General Electric Co., Ltd.), Erith, Kent.—Bulletin 13B, describing and illustrating single stage impulse type turbines for small outputs.

THE WHITWORTH ELECTRIC LAMP CO., LTD., 195, North End Road, West Kensington, W.14.—A net trade price list of electrical accessories, including conduits and fittings, cables, lamps, switches, fuses, &c.

MESSRS. DONOVAN & CO., 47, Cornwall Street, Birmingham.—A well-illustrated booklet, giving details and prices of lampholders, switches, lamps, wall plugs, ceiling roses, and numerous other electrical fittings.

DRAKE & GORHAM WHOLESALE, LTD., 67, Long Acre, W.C.2.—An illustrated folder giving a description of a pocket electroscope and the uses to which it can be put.

MESSRS. TOFIELD & ROBINSON, LTD., 165, Edmund Street, Birmingham.—Stock list of new and second-hand a.c. and d.c. motors.

Catalogues Wanted.—MR. A. STRETCH, who is setting up business at 38, Conway Street, Birkenhead, desires to receive catalogues of lighting and heating fittings and model electrical apparatus.

SOCIETE INDUSTRIELLE D'ELECTRICITE (FRANCE), 23, Queen Anne's Gate, London, S.W., who manufacture only safety cartridge fuses, desire to receive catalogues of electrical material, including all kinds of accessories, fittings, insulating material, &c., for their home and export trade.

A Conundrum.—Our reference to this subject last week was premature, as we find that the mysterious numerical advertisement did not appear in that issue. However, we understand that the brain-twister will certainly be launched on an expectant world this week. The attention of Messrs. Holmes, Watson & Co. is invited.

Calendars and Almanacs.—THE LIVERPOOL ELECTRIC CABLE CO., LTD., of Linacre Lane, Bootle, Liverpool, have issued a wall calendar with monthly slips. The pictorial feature is a coloured view showing the "*Mauretania* in the Mersey."

The GILBERT ENGINEERING CO., of 8, Church Street, Colmore Row, Birmingham, has sent us a wall calendar for 1922. The card shows the complete year, in addition to giving a block of daily slips.

From MESSRS. MCWHIRTER & SONS, LTD., of Wharf Street, Cardiff, we have received a wall calendar with daily slips beneath a view of repair work carried out in position on a 1,000-kW generator.

From MESSRS. MOIR & WATTS, of Weardale Road, Lee, S.E.13, there has come to hand a neat wall calendar. A coloured picture, "The Fugitives," appears above a set of monthly date slips for 1922.

A Business Efficiency Exhibition.—A Business Efficiency Exhibition, organised by the Association of Office Appliance and Equipment Manufacturers and Traders, will be opened by Mr. Gordon Selfridge in the Central Hall, Westminster, on February 8th. It will be open for ten days.—*Daily Mail.*

Our Foreign Trade.—DECEMBER FIGURES.—The following were the values of imports and exports of electrical goods and machinery during December, 1921:—

	December, 1921.	Inc. or dec.	12 months, 1921. Inc. or dec.
Imports.—	£	£	£
Electrical goods and apparatus	124,295	−157,981	+106,185
Machinery	521,636	−1,206,265	−9,168,792
Exports.—			
Electrical goods and apparatus	750,751	−589,531	+1,464,265
Machinery	5,257,123	−1,915,906	+11,198,127
Re-exports.—			
Electrical goods and apparatus	11,800	−11,851	+58,092
Machinery	75,565	−51,544	−441,449

Australia and ex-Enemy Trade.—The Federal Government will revoke the prohibition of trade with ex-enemy countries on August 1st next. Conditions will be imposed for the protection of holders of stocks.—*Reuter's Trade Service* (Melbourne).

Social Events.—The Athletic and Recreation Club of Messsr. J. H. Tucker & Co., Ltd., held its annual New Year's invitation social on the 5th inst. Dancing, a concert, and whist were arranged in the way of amusements, and the canteen was tastefully decorated. Bon-bons and other Christmas and New Year novelties and refreshments were provided. The concert section of the programme was provided by members of the company. Mr. T. R. Martin occupied the chair. There were no speeches beyond the usual vote of thanks to the committee, after which prizes were distributed to the winners of the whist drive, and dancing was continued.

For Sale.—By order of the Disposal and Liquidation Commission. Mr. M. Marshall will sell by auction at the Royal Naval Dockyard, Rosyth, on January 24th and 25th, a contractor's plant, including petrol-electric generating sets, dynamos, electric-driven winches, motor alternators, pumps, &c.

ENAMELLED WIRES, LTD., IN LIQUIDATION.—The above business is offered as a going concern by the liquidator.

Included in the sale to be conducted by Messrs. Leopold Farmer & Sons, on January 26th, at the Dover Castle, 7, Great Dover Street, Borough, of the metal-plating and depositing plant and machinery of Radiator Tubes, Ltd., will be—generating sets, plating dynamos, and electric motors. For particulars see our advertisement pages to-day.

Reparations.—We must not indulge any sense of false security with regard to the reparations in kind proposals and their bearing on British super-power station and railway electrification work. While it is true that the matter has not been prominently forward in the Press lately, it must not be taken for granted that the negotiations and discussions on the Continent will rule out all measures of the kind. One thing, however, is certain, and that is that the outcry and opposition that burst forth in November and December last were but small compared to the uproar that will greet any revival of proposals which will chain British electrical engineering interests to German feet. It will be remembered that the I.E.E. and other electrical organisations laid their considered arguments before the Government, and we have now received a copy of the letter which was addressed to the Prime Minister, under date December 21st, by the Director of the British Engineers' Association, stating the grounds on which the B.E.A. takes the strongest possible objections to the suggestions advanced in the Press and at the F.B.I. meeting. The B.E.A. also addressed a letter on the same date to the F.B.I. objecting to the manner in which the latter allowed the personal views of Sir. P. Rylands to have publicity.

On another page we refer to the F.B.I. discussion of last week, a report of which has just come to hand.

The Johannesburg Strike.—The course of the strike of miners in the Johannesburg area is indicated in a series of *Reuter* telegrams. On January 10th, the strike was complete except for a small detachment of men retained to maintain essential services. The following day several mines were reported to be water-logged, but there was no violence. All labour organisations were warned by their Executive to hold themselves in readiness to strike. On the 13th, essential services were withdrawn, but a section of the men was reported to hold the view that this action should not have been taken. On the 14th a seven-a-side conference was agreed upon and a meeting of the conference lasted all the next day, no agreement being arrived at. Mines at Kleinfontein and Modder East were reported to be flooding. It was decided to repatriate large contingents of natives on January 16th, and they were marshalled in the compounds ready for entrainment. The question of a general strike was still under consideration.

The Position of the Electrical Industry.—The Birmingham and District Electric Club held the first meeting of the new session at the Grand Hotel, on Saturday last, when Mr. Norman Deykin, the new president, delivered his inaugural address. The Club, he said, had arrived at the first meeting of its eighteenth year, and it was more successful at this moment than it had ever been. The speaker proceeded to consider the immediate prospects of the electrical industry. The year through which we had just passed was, he said, probably the worst that the industry had ever experienced, and the main thing to consider at the moment was what could be done to re-gain our vanishing trade. There were no prospects of a boom but there should be a steady expansion, to assist which, the primary need was reduction in price, but even this could not secure business in foreign markets against the extraordinarily low prices of Continental competitors, largely by reason of the unbalanced exchanges. In the home market it was essential that there should be more effective protection for the English manufacturer, but reduction in prices and increased production were necessary steps in the direction of increased trade. It was also important for manufacturers to give greater support to their selling organisation and the needs of their customers. The volumes which had been written upon "The Art of Salesmanship" might be usefully supplemented by one upon "The Art of Supporting a Salesman." There was a great dearth of good electrical showrooms for the education of the non-electrical public; Americans were much more alive in this respect. Mr. Deykin said that the cost of electrical energy was too high. It was worth considering whether it might not be wise even to increase the price of electricity for lighting purposes, making a corresponding decrease in the price for power, cheap electrical energy for manufacturers being vital in the struggle for trade.

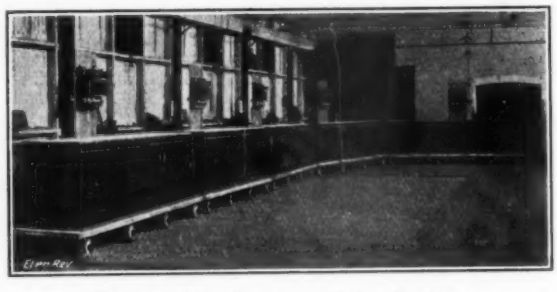
Increased Discounts.—Messrs. Faraday & Son, Ltd., of 146-150, Wardour Street, London, W, announce increased trade discounts for electric fittings, &c. An enlarged catalogue is in the press.

Reported Power Station Activity in Russia.—An Exchange report from Stockholm (appearing in the *Daily Herald*) credits a member of the Russian commercial delegation in Sweden with stating that Sweden will receive a big order for turbines for the Russian power stations which are now being constructed, especially in the Wolchow district, where 1,300 men are now at work. The report adds that the number of men is to be increased to 3,000 next year.

This matter is also referred to in a Reuter dispatch from Stockholm. This states that, according to *Dagens Nyheter*, the Russian Professor M. Graftio, who is at the head of certain Russian electrification works, declares that an agreement has been practically concluded with Nydquist & Holm, at Trollhattan, and the mechanical workshops at Kristinehamn and Karlstad for the delivery of turbines for Russian power stations, especially for the central station at Zwanka, in the Wolchow district. The turbines will have a total horse-power of 80,000. The agreement regarding generators and transformers has not yet been concluded, and it is probable that offers will be invited from Scandinavian, American, and German firms. "These orders for turbines are considered a good omen for the negotiations in connection with the commercial treaty with Russia, which are said to be proceeding satisfactorily."

Trade with Morocco.—Mr. C. R. B. Atkinson, M.B.E., H.M. Commercial Secretary for Morocco, who will shortly leave England to proceed to his post, is at present at the Department of Overseas Trade. Firms who desire to obtain from him information as to the possibilities of extending their trade with Morocco firms should communicate before January 25th with the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1, quoting the reference 3,617 T.G. Mr. Atkinson wishes to receive catalogues of all kinds from British manufacturers addressed to him c/o His Britannic Majesty's Agency, Tangier, Morocco.

Electric Hot Cupboards for an Irish Canteen.—The accompanying photograph shows a consignment of electric hot-cupboards just before dispatch to a canteen in Ireland. The cupboards, which were supplied by the Jackson Electric Stove Co., Ltd., are 10 ft., 12 ft., and 13 ft. long, all 2 ft. 9 in. high x 2 ft. from back to front, and are fitted with sliding



ELECTRIC HOT CUPBOARDS FOR A CANTEEN.

doors on one long side. The cupboard and top are each separately controlled and independently heated, each section being split into two circuits, and each arranged for three-heat regulation. The connections are of the usual Jackson type, namely, solid rod mounted on porcelain insulators. The 10-ft. cupboards are fitted with three sliding doors and the 12-ft. and 13-ft. cupboards with four sliding doors.

Lead.—In their report dated January 14th, Messrs. James Forster & Co. state:—"Copper, tin, spelter, and lead have all been depressed this week and show considerable declines. Lead has been throughout apathetic.

"With regard to recent arrivals, all the lead is wanted as some consumers have been reduced to bare boards, but the quantity in is sufficient for current needs. The trade continues buying only from hand to mouth.

"Germany continues buying but is supplied direct from America, and France draws from the same source."

THE BOARD OF TRADE RETURNS FOR DECEMBER ARE:—

Imports	10,888 tons
Exports	2,620 "
Left for home consumption	8,268 tons

The figures for the 12 months January/December, 1921, come out as follows:—

Imports	132,602 tons
Exports	28,069 "
Available for home absorption	104,533 tons
To which must be added	18,761 tons from stock.
Making in all	123,394 tons
Against	137,007 tons for 1920.

E.T.U. Wages Dispute.—A wages dispute between members of the Electrical Trades Union and the St. Helens (Lancs.) Group of Manufacturers was referred to the arbitration of Mr. James Sexton, M.P. The employers wanted to reduce wages by 6s. 9d. and to abolish the 12½ per cent. bonus, whilst the E.T.U. claimed adherence to an agreement of April, 1920, which they said did not entitle the employers to reduce wages by 16s. 6d., similar to the engineers' (6s. 9d. and the 12½ per cent.). The award of the arbitrator favoured the E.T.U.'s contention regarding the 1920 agreement. The men, therefore, will only suffer a reduction of 14s. 1d. per week, whilst the auxiliary men are subject to a cut of 11s. 9d.

Book Notices.—"*Mechanical World Year Book*, 1922." Manchester: Emmott & Co., Ltd. Price 2s. 6d. net.—As is the nature of such works, this year book continues to grow. The principal alterations and additions are a new section on "Pipes and Tubes," giving particulars of wrought and cast iron, steel, and copper pipes of several types; the section on "Boiler Construction" has been rewritten and enlarged; and the tables of "Thermal Properties of Solids, Liquids, and Gases," and "Weights of Hexagonal and Octagonal Bars" have been restored by request.

The *Bulletin* of the Hydro-Electric Power Commission of Ontario; Vol. VIII, No. 5, September-October, 1921. Toronto: The Commission.—This issue contains notes on the Commission's accounting system; "The Testing of Flexible Insulation"; and notes of proceedings of the Association of Municipal Electrical Utilities.

The *Transactions* of the South African Institute of Electrical Engineers, Vol. XII, parts 10 and 11. Price 2s. net each.—Part 10 includes discussions on a paper upon "Recent Developments in Steam Turbine Design"; on "The Development of Wireless Engineering"; and "Reinforced Concrete Poles for Overhead Line and Traction Work." Part 11 includes papers on "Recent Developments in Wireless Telegraphy"; and "Tests and Observations on Thermionic Valves."

"Real Mathematics," by E. G. Beck. Pp. ix+306, figs. 103. London: H. Frowde & Hodder & Stoughton. Price 15s. net.

The *Journal* of the South African Institution of Engineers, Vol. XX, No. 5, December, 1921. Price 3s. net.—This number contains a paper on "Oil for Power Production; Some Notes on Recent Developments of Diesel and semi-Diesel Engines," by Mr. J. H. Dobson.

Post Office Electrical Engineers' *Journal*. Vol. XIV, part 4. January, 1922. ELECTRICAL REVIEW, Ltd. Price 2s.

"Radio Questions and Answers on Government Examination for Radio Operator's Licence," by A. R. Nilson. Pp. ix+85, figs. 40. London: McGraw Hill Book Co. Price 5s. net.

"Engineering Abstracts from Current Periodical Literature." New Series. No. 10, January, 1922. London: The Institution of Civil Engineers.

The Edinburgh Exhibition.—The Edinburgh Branch of the Electrical Contractors' Association of Scotland has decided to run a joint electrical stall at the Ideal Homes Exhibition which is to be held in the Waverley Market during February. A representative show of the most modern household labour-saving apparatus and decorative fittings is being arranged by a committee of contractors. Manufacturers of domestic electrical appliances are invited to communicate with the Secretary, Mr. Walter Finlay, W.S., 55, Frederick Street, or Mr. D. S. Munro (vice-president of the Association), 11, Randolph Place, Edinburgh.

Stoker Contracts.—During the past month the UNDERFEED STOKER CO., LTD., received the following orders: For the Nottingham and Belfast Corporations, 18 and 12 travelling grate stokers respectively; for Tokio Exhibition, one travelling grate; ash conveyors for Wolverhampton Corporation, State Electricity Commissioners, Victoria, N.S.W., and Kure Arsenal, Japan.

Norwegian Steel Works.—The budget of the Norwegian State Watercourse and Electricity Administration for the coming financial year shows an estimated expenditure of 3,033,774 kr., and receipts amounting to 456,883 kr., or a deficiency of over 2,500,000 kr. Various extensions of works have been struck out on the score of economy.

Aerial Photograph of Works.—We have received from the General Electric Co., Ltd., a reproduction of an aerial photgraph showing the Pirelli-General Cable Works at Southampton. It gives a very good idea of the size of the works and of the way in which they are laid out.

Electricity and Bavarian Competition.—A correspondent of the *Birmingham Gazette*, who has just completed a tour throughout Central Europe, says that there is no doubt that the strong competition with the Midlands carried on by Bavaria in numerous directions is due in a large measure to the plentiful supply of electricity which is available. Not only are the big industrial establishments in the chief towns supplied, but the smallest villages and the outlying districts are also within the scope of the extensive networks of the country.

Price Reductions.—THE FALKIRK IRON CO., LTD., announce that they have reduced their prices to the trade for electric fires.

Copper and Lead Prices.—MESSRS. F. SMITH & Co. report, January 18th: Copper (electrolytic), bars, £73, 10s. decrease; do. do. sheets, no change; do. do. wire rods, £89 10s., 10s. decrease; do. do. h.c. wire, 11¼d., 1-16d. decrease.

MESSRS. JAMES & SHAKESPEARE report, January 18th: Copper bars (best selected), sheet and rod, no change; English pig-lead, £25; £1 decrease on last week's prices.

The Metropolitan-Vickers Co.'s London Showrooms.—THE METROPOLITAN-VICKERS ELECTRICAL CO., LTD., has recently opened new showrooms at 232, High Holborn, W.C.1. These splendidly-equipped premises are very centrally situated, being adjacent to Kingsway (Holborn end), and practically adjoining the Holborn Tube Station.

The new showrooms consist of a ground floor and basement—a total floor area of about 4,000 square feet. The basement is arranged with a complete display of electrical fittings, accessories, heating and cooking appliances and lamps, while a trade counter provides facilities for dealing promptly and efficiently with contractors' orders.

The photograph reproduced in fig. 1 gives a general view of the ground floor, and indicates the care which has been taken

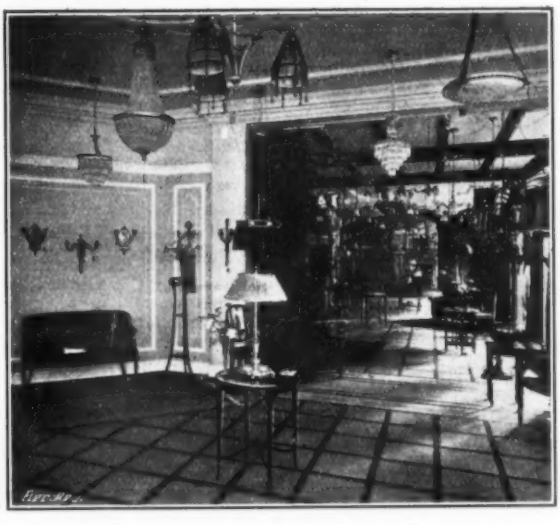


FIG. 1.—GENERAL VIEW OF GROUND FLOOR.

in the grouping of the various fittings. In order to display the electrical fittings, as far as possible in their appropriate surroundings, the showroom has been divided up into sections representing respectively the Adam style, and the Jacobean and Georgian periods. An annexe has been decorated and furnished throughout in the William and Mary style.

Fig. 2 shows the kitchen, where daily demonstrations of cooking by electricity and the use of electric household appliances are given by an expert lady assistant. The kitchen is designed on the most hygienic and up-to-date lines.

FIG. 2.—THE KITCHEN.

The showrooms were wired, furnished, and decorated throughout by Messrs. Harrod's Ltd., to whom great credit is due.

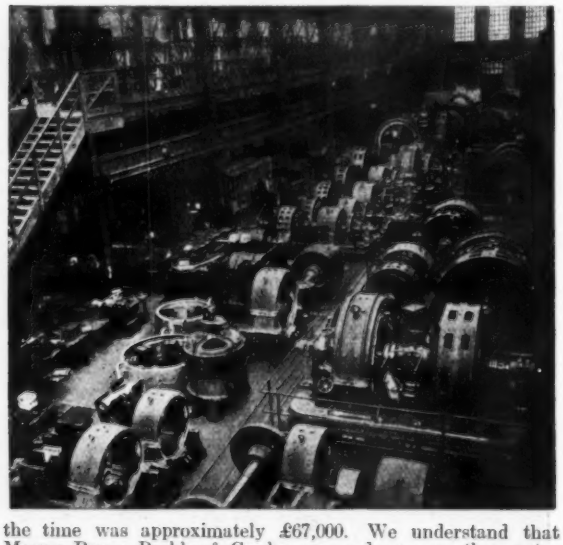
The policy of the company is to protect the interests of electrical contractors and retailers, all of whom are invited to regard the particular showroom in their vicinity as an extension of their own premises. To this end books of specially-designed introduction cards are supplied free to the trade. These cards can be handed to prospective purchasers, introducing them to the nearest showroom for the purpose of witnessing a demonstration of any electric household appliance or fitting in which they may be interested, sales resulting from such introductions, being credited to the retailer concerned.

Electrical Exhibitions.—THE WESTMINSTER ELECTRIC SUPPLY CORPORATION'S usual quarterly exhibition is at present being held at its premises at 6, Eccleston Place, S.W.1, and this time the company is making a speciality of ironing and washing. The "Bluebird" washing and ironing machines are shown in operation, and also the 5 lb. domestic electric iron, which is hired to consumers at 2s. 6d. per quarter. There are many types of electric fires and cookers also to be seen in operation, including the "Utility" cooker-radiator, which will either heat a small room or boil and grill at the same time. The new "Dowsing" 500-W bowl fire is also on view.

Cookers of various manufacturers are shown, and now that the Corporation has reduced the rate of charge for energy by 25 per cent. this should boost up its heating, cooking, and power load considerably.

The IPSWICH CORPORATION has arranged a display of electric heating, cooking, and domestic appliances at its showrooms in Princes Street. The majority of the appliances shown were provided by the General Electric Co., Ltd.

Bruce Peebles's Heavy Test Plate.—We believe the illustration which we reproduce herewith will be of interest to many of our readers. It shows part of the heavy test bed at the works of Bruce Peebles & Co., Ltd., Edinburgh. At the time when the photograph was taken (November 21st) some eleven Peebles-la Cour motor converters were under test, in addition to two 300-kW induction motor-generators for Tasmania. The eleven motor converter sets included one of 1,500 kW, three of 1,000 kW, one 600, five 500, and one of 300 kW. The value of the machines actually under test at



the time was approximately £67,000. We understand that Messrs. Bruce, Peebles & Co. have on order many other motor converter sets, in addition to orders for all the other types of electrical machinery which they manufacture.

The 1,500-kW motor converter mentioned above is for the Edinburgh Corporation, and the makers have in hand for that Corporation six 1,500-kW and two 500-kW motor converters, two 500-kW synchronous motor generators, and a three-machine battery booster, in addition to a large number of both vertical and horizontal auxiliary motors for the condensing and coal-handling plant.

Electric Locomotive for Glasgow. — The *Newcastle Chronicle* says that an order for an electric storage-battery locomotive has been placed with the Electric Locomotion and Foundry Co., Ltd., of Gateshead, by the Glasgow Corporation. The company is also supplying similar locomotives to local collieries.

The Mexican Motor Exhibition.—In connection with the large international motor exhibition which is to be held in Mexico City in April next, the *Financier* states that it is in touch with Mexican officials, and offers help to any of its readers who require space in the exhibition or any information.

Kinema Operators' Wages.—The *Bioscope* says that the wages of chief kinema operators have been reduced by 10 per cent., and those of second operators by 7 per cent.,, as from January 2nd.

The Position of the Amalgamated Engineering Union.—According to the *Sheffield Independent*, the January issue of the journal of the A.E.U. stated that the year 1921 was abnormal in regard to unemployment, and the funds of all trade unions were subjected to a very severe strain. The A.E.U. expended in unemployment benefit alone £2,043,423. "Our income at the present moment does not meet our expenditure, and it may be necessary in the immediate future for the Council to consult the membership with a view to providing the necessary funds to enable the organisation to meet its liabilities." The percentage of unemployed members is now 26.05, and in December the membership suffered a further decline of 3,795.

LIGHTING AND POWER NOTES.

Aberystwyth.—SEWAGE PUMPING PLANT.—A Ministry of Health inspector held an inquiry on January 10th into the Council's application for sanction to a loan of £34,632 for the installation of a sewage disposal plant. It was stated that electrical pumping would be employed, and power would cost about 2d. per unit at the commencement.

Australia.—VICTORIA.—The second annual report of the Victorian Electricity Commission has been issued. The report consists chiefly of a review of the preliminary work, leading up to the acceptance of tenders for the supply and delivery of plant and apparatus for the Morwell scheme. Until June, 1923, when it is expected that the Newport "B" power station will be in operation, the Commission is to be supplied with a maximum of 12,500 kW of 25-cycle energy from the railway power house for distribution to consumers other than the Railway Department. The Commission has the right to purchase for distribution all electrical energy (the production of either or both power houses) which may be surplus to the railway requirements, this surplus being over and above the 12,500 kW referred to. When the new Newport station and the Morwell power station are in operation, both these stations and the Newport railway power station will be linked. In November, 1920, the commission recommended to the Ministry that the Kiewa scheme should not be proceeded with, as the existing demand of the metropolis was not sufficient to justify its embarking on the execution of a hydro-electric scheme of the nature and magnitude outlined. The Commission proposed to continue hydro-electric investigations on a more modest scale for the service of North-Eastern towns or groups of towns.—*Reuter's Trade Service* (Melbourne).

ST. GEORGE COUNTY (N.S.W.).—The St. George County Council, in the Bathurst district of New South Wales, is arranging a loan of £100,000 for the installation of an electric light and power plant for municipalities in the Bathurst district.

TASMANIA.—The Tasmanian Hydro-Electric Department is to supply electricity to the municipal councils in Southern Tasmania at £12 per annum per electrical horse-power. A high-pressure main feeder line will carry power at 6,000 or 10,000 V to a delivery point to be selected, and the councils will provide transformers.—*Reuter's Trade Service* (Melbourne).

Barnes.—PROPOSED EXTENSION OF PLANT.—The electrical engineer reports that the present plant will be inadequate to carry the estimated load during the winter of 1922-3, the shortage representing about 500 kW. He has therefore been instructed to prepare a report with detailed estimates upon the installation of a further turbo-generator set and a rotary converter.

Bootle.—EFFECTS OF TRANSFER.—The chairman of the Electricity Committee recently stated that there was a net debt on the Bootle undertaking of £160,129. Liverpool would have the right to charge meter rents, but to balance that the lighting consumers would obtain electricity for a farthing less per unit than at present. Existing agreements between the Bootle Corporation and its consumers would remain in force, and Bootle would have representation on the Liverpool Electricity Committee. It would have cost Bootle about £120,000 to install extra plant needed to meet the demand if the development of that undertaking had been embarked upon.

Bo'ness.—BULK SUPPLY.—The Town Council has concluded an agreement with the Scottish Central Power Co. for a bulk supply of electricity. The new arrangements will entail an expenditure of £10,000.

Canada.—DEVELOPMENT OF THE ST. LAWRENCE RIVER.—The *Electrical News* of Toronto states that the Hydro-Electric Power Commission of Ontario has recently presented a report upon the hydro-electric possibilities of the St. Lawrence to the International Joint Commission. It is stated that the potential power of the St. Lawrence amounts to more than twice that of the Niagara Falls. The report points to three main sections which could be profitably developed:—The upper section has a fall of 90 ft. in a length of 60 miles, 80 or 85 ft. of which could be utilised for power development. The middle reach is about 15 miles long and has a fall of 82 ft., of which 75 ft. could be employed. The third and lowest reach has a fall of 45 ft., 30 or 35 ft. being the utilisable head. The whole of this power is estimated to be in the neighbourhood of 4,000,000 24-hr. horse power. Only about 300,000 h.p. has been developed on the St. Lawrence up to the present; one third of this is on the American side. Three schemes of development have been suggested, but the one regarded most favourably is one which aims to carry the work out in two stages to develop 1,600,000 h.p., at an estimated cost of $154,100,000.

Cannock.—MAXIMUM PRICE FIXED.—The Urban Council has decided that the maximum charge for electricity for lighting purposes shall be 8d. per unit. Further applications have been received from the local collieries for supplies of electricity for power purposes.

Clacton.—LOAN.—Application is being made for sanction to borrow £1,300 for the provision of an additional feeder cable to Anglefield.

(*Continued on page 93*).

THE "REGENT" THEATRE, BRIGHTON.

When the directors of Provincial Cinematograph Theatres, Ltd., who already control seventy kinema theatres, decided to erect a building in Brighton that would be adequate to the needs of London-by-the-Sea, it was immediately recognised that a theatre very much out of the ordinary run was called for, and arrangements were therefore made for a small staff party, including the company's engineer, to visit the United States and Canada to study the latest practice in theatre construction and equipment from the Atlantic to the Pacific.

Fig. 1.—Main Switchboard.

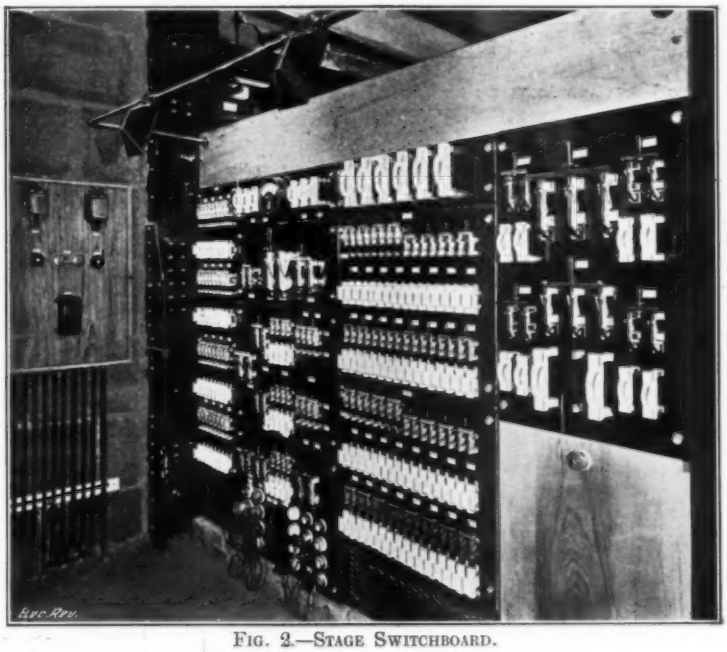


Fig. 2.—Stage Switchboard.

Mr. Robert Atkinson, F.R.I.B.A., of Bedford Square, London, was the architect, and Messrs. McLaughlin & Harvey, Ltd., of London and Belfast, were the principal contractors for "The Regent," which is situated at the corner of Queen's Road and North Street, facing the Jubilee Clock Tower, a central position about equi-distant from the railway station and the sea front.

The building, which represents a capital outlay of £400,000, comprises the main theatre, seating 2,300, the Italian Restaurant on the first floor, overlooking Queen's Road, which seats 200, the Ship Café, leading off the main foyer and seating 100, and the Foyer Café, seating 100. The Winter Garden, situated on the roof of the theatre, will, when completed, seat over 1,000 people, and fine views will be obtainable from its delightful pergolas. The Winter Garden, Italian Restaurant, and Ship Café are fully licensed for a seven-day week.

It will be seen, therefore, from this brief description, that the engineers were faced with the problem of providing electrical and mechanical equipment for the comfort, entertainment, convenience, and refreshment of upwards of 3,500 patrons, plus a staff of 300 musicians, attendants, engineers, waiters, &c., &c., concentrated on a site area of approximately 24,000 sq. ft.

One of the many interesting engineering features of the building, although not directly of electrical interest, is the balcony, designed by Dr. Oscar Faber, O.B.E., and erected by Messrs. Redpath Brown & Co., Ltd. It has a clear span of 110 ft. and a projection of over 50 ft., and is designed to seat 750 patrons, representing a dead load (distributed) of 50 tons. Reference to fig. 7 will show clearly that there are no pillars, and that every patron seated either on the ground floor or in the balcony has a clear and unobstructed view of screen and stage.

The supply of electrical energy to a building of the size and type indicated above (maximum site dimensions 220 ft. by 170 ft.) with an estimated maximum demand exceeding 200 kW when completed, was a matter for careful consideration, and the question of steam generating plant, utilising the exhaust steam for heating and cooking purposes, was investigated. The problem presented many unusual features, chief of which were the difficulties of access to the only available space for the engine room and boiler house (under the auditorium floor), risk of objectionable noise or vibration during organ recitals and orchestral concerts, relatively small and intermittent demand for exhaust steam for cooking and hot water supply (which was estimated not to exceed 800-1,000 lb./hr.), the absence of any heating load during six months of the year, hardness of feed water, the absence of any roof space for cooling tanks or evaporative condensers, and the undesirability of running non-condensing and discharging exhaust steam alongside or immediately above the pergolas of the Winter Garden. Negotiations were therefore entered into with the Borough Electrical Engineer, Mr. John Christie, M.I.E.E., and a contract was eventually signed with the Brighton Corporation for a period of years, based on a fixed charge per kilowatt of maximum demand, plus a

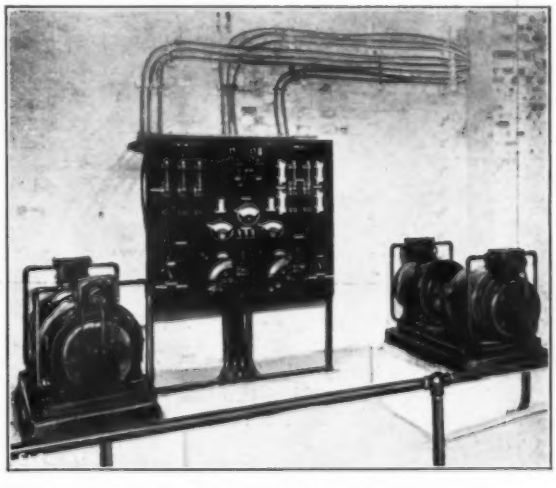


Fig. 3.—Balancer and Switchgear.

running charge per kWh, with a minimum guaranteed sum per annum; provision was made for variations in the cost of coal, both in the running charge and in the minimum guaranteed sum.

A bulk supply, on the 3-phase system at 8,000 volts, was first discussed, but arrangements were finally made for a d.c. supply on the two-wire system at 230 volts. For convenience, and to ensure continuity of supply, two feeders, each of one square inch section, were laid direct from the North Road sub-station, and, together with a heavy service from the local network, were brought into the building and connected to the main feeder board, situated in the basement. This main board (shown in fig. 1) is really composed of two boards, the four panels on the left, supplied by the Metropolitan-Vickers Electrical Co., Ltd., being the property of the Brighton Corporation. The three remaining panels, on the right, control the main feeders in the building, and were supplied by the Park Royal Engineering Co., Ltd. At present twelve feeders are connected, but provision has been made for adding further panels as and when required at minimum cost and inconvenience.

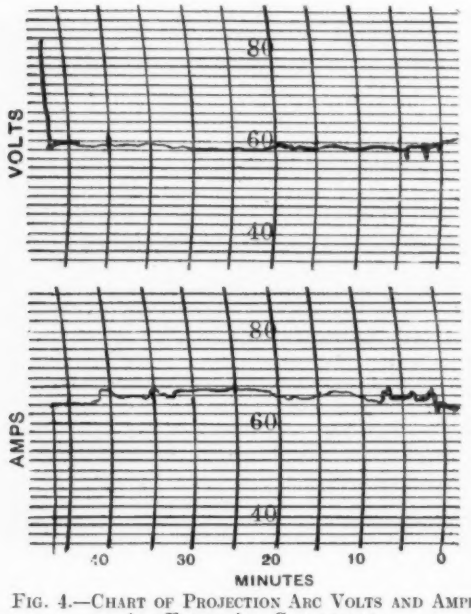


Fig. 4.—Chart of Projection Arc Volts and Amperes; Arc Fed by Arc Controller.

Fig. 6.—"The Regent," Stage View. (By the courtesy of Mr. Robert Atkinson.)

At the time when orders were being placed, it was considered that although pictures would form the staple "diet" of the theatre patrons, yet elaborate stage settings and possibly stage plays might be produced later, which would call for a comparatively heavy stage lighting load, probably at short notice. A 0.2 sq. in. feeder was therefore run to the stage, and a three-colour stage switchboard, having duplicate bus-bars and change-over switches, supplied by the Park Royal Engineering Co., Ltd., was installed. Provision has been made on this board whereby, by means of plug connectors, a part of the stage lighting can be transferred to the theatre main circuit during ordinary picture programmes, thus avoiding the cost of a switchboard attendant, when he would not otherwise be required.

Fig. 5.—Projection Room.

Since, by the terms of the agreement, the whole supply is metered in bulk, through one meter on the main switchboard, it was considered unnecessary to differentiate between lighting, cooking, and the steady power load. Common feeders, therefore, were run to double-pole, ironclad fuse boards, located at convenient centres, and sub-feeders, radiating from these boards, are connected to motors and to lighting sub-fuseboards, of a similar character, in the locality. The only exceptions to this standard are the lifts, and the balancers (referred to later) which, in view of the intermittent nature of the load, are connected by special feeders direct to the main switchboard.

Careful investigation of the costs at the time when the installation was planned indicated that up to and including 0.1 sq. in., the usual v.i.r. taped and braided cables and conduits were the cheapest and most satisfactory proposition, but for 0.125 sq. in. and larger sizes, galvanised armoured cables, cleated to the walls, showed a considerable advantage in price, and

were adopted where the whole run was accessible after completion of the building. Henley's cables, Griffith's conduit, and Kartret fuseboards were used exclusively.

The supply for the projection room and the stage arcs and incandescent focus lamps next came under review, and, due to the fact that the supply was on the two-wire d.c. system at 230 volts, it was decided, after consultation with the makers, Messrs. Electromotors, Ltd., not to install the company's standard 100-volt, 100-amp. d.c. motor-driven generator set, but to take four of these standard generators to form two balancer sets, each rated for 180 amp. in the middle wire, with close automatic voltage regulation, and to make a special three-wire system inside the building. This arrangement provides a low-voltage supply to the projection room and stage

Fig. 7.—"The Regent," Balcony View.

simultaneously from one running machine, which normally operates at a satisfactory efficiency figure, provides a practically unlimited supply of energy at 115 volts, and deals most satisfactorily with the normal out-of-balance current of 100-120 amperes, which changes from side to side every 15 or 20 minutes (see fig. 3).

The projection room is equipped with two film projectors, one slide lantern, and one 25/50-ampere spot light, connected in series with separate grid type resistances having a negligible temperature coefficient, and supplied by Messrs. Allen West & Co., Ltd., of Brighton. These resistances, which are designed for a maximum current of 100 amperes, have no adjustable features of the standard type, but are fitted with terminals at definite points, so that if necessary the current value can be altered. They are all fixed in a separate, well-ventilated room, and by this means a high temperature in the projection room is avoided.

The modern tendency is to use long films running into several thousand feet, and from a fire risk and several other points of view, it is inconvenient to arrange projectors to take more than 1,200 to 1,500 feet of film. Patrons naturally object to interruptions in the unfolding of the story, due merely to mechanical causes, and therefore the projection engineer has to provide apparatus which will enable the operator to make invisible change-overs between machines in multiple-reel films. With the three-wire system above described, this is a simple matter, for, with one projection arc running at 80 amperes on one side of the system, the second arc is switched in in series with its full resistance and takes 25/30 amperes. In about 30 seconds, when the crater is established, and the condenser lenses have been warmed up, a portion of the resistance is short-circuited by means of a 100-amp. "Igranic" single-pole, clapper-type switch, operated by a 3-amp. tumbler switch from the machine stand, and the current rises to 80 amperes, which is the normal load, and a balance is effected. The second arc (incoming machine) is now ready, and at the end of the reel, on the running machine, by means of two 3-amp. corridor-type switches and solenoid-operated shutters, connected across the motor, the motor is started, the shutter of the incoming machine raised, and the motor stopped and the shutter lowered on the outgoing machine simultaneously, by one man. Special arc controllers or feeding devices designed by Mr. Haydn T. Harrison, M.I.E.E., and Mr. Ronald Grierson, A.M.I.E.E., which hold the arc voltage constant within 2 per cent. are fitted to each projector, so that given good

Fig. 8.—Projection Room Control Panel.

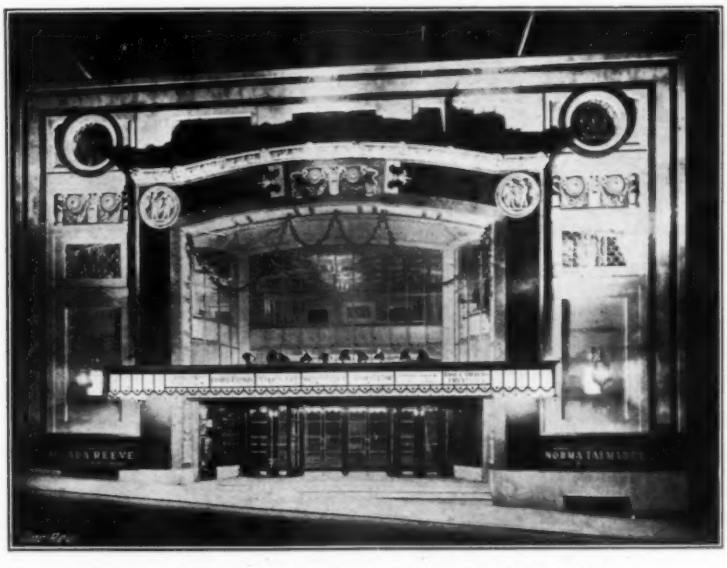


Fig. 9.—"The Regent" Flood Lighting, Queen's Road. (By the courtesy of Mr. Robert Atkinson.)

carbons, once the arc is struck, it requires no further attention throughout the run, and a steady feed is maintained. Adjustments are provided for varying the feed voltage, depending on the current and grade and type of carbon used. (See chart, fig. 4.)

In connection with projection arc lamps, it is interesting to note that the efficiency of the most modern projectors (*i.e.*, the ratio of the lumens emitted by the screen to the lumens emitted by the arc) rarely exceeds 3 per cent. Assuming a 20-ft. screen, the area of which is approximately 320 sq. ft., an illumination intensity, without film and with shutter stationary, of 8 foot candles would be considered very satisfactory. In this case, the screen lumens would be 2,560, and an 85-ampere arc at 54 volts would be used. According to Jean Rey, the arc flux would be:

$$\Phi = 18.06\ W + 9{,}740,$$

or, say, 93,000 lumens, or 20.2 lumens per watt, and the overall efficiency between the arc terminals and the screen would be 2.78 per cent. This problem has been closely investigated by Mr. H. T. Harrison and Mr. Grierson, with the result that new apparatus having an efficiency of 10 per cent. will shortly be placed on the market. No windows are provided in the projection room, and to remove the heat and fumes emitted by the arc lamps (four, taking 230 amps., may conceiv-

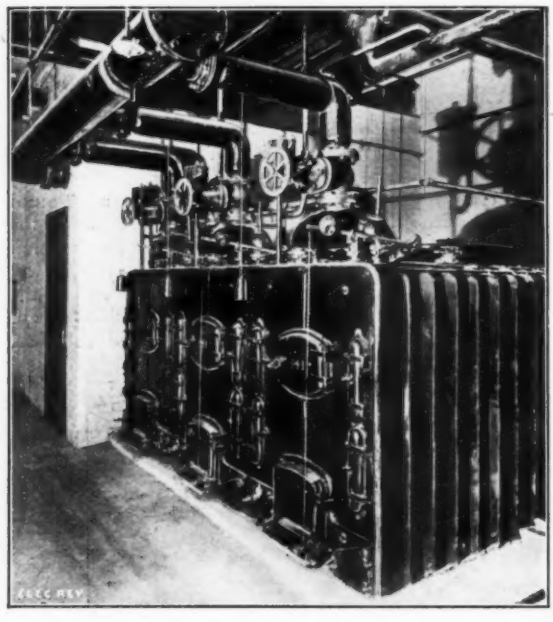


Fig. 10.—Heating Boilers.

ably be burning at one time for special effects), a cased centrifugal exhaust fan, rated for 1,500 cu. ft./min. against 0.5 inch w.g., supplied by Messrs. Jas. Keith and Blackman, Ltd., is provided and connected to each lamp-house; ample natural inlets, trunked to the open air, are provided. The room is thus kept under a lower pressure than the theatre and adjacent corridors, so that in the remote event of a film fire, all smoke and fumes will be quickly removed, and cannot escape into the public portions of the building. A 12-volt pilot circuit, connected to lamps fixed alongside the film track, and in the lamp-houses, is provided to facilitate threading up and accurately framing films without flooding the room with light and thus rendering the distant screen picture comparatively invisible to the operator.

The general illumination equipment called for a considerable amount of study and test work on the absorption of dyed fabric and cathedral glass, due to the novel fittings adopted by the architect to harmonise with the various decorative schemes.

The main lighting of the theatre (see figs. 6 and 7), which takes approximately 15 kW, is handled by a 20-second motor-driven dimmer located in the basement, and operated by push-button remote-control gear from the projection room and also from the stage. A 100-

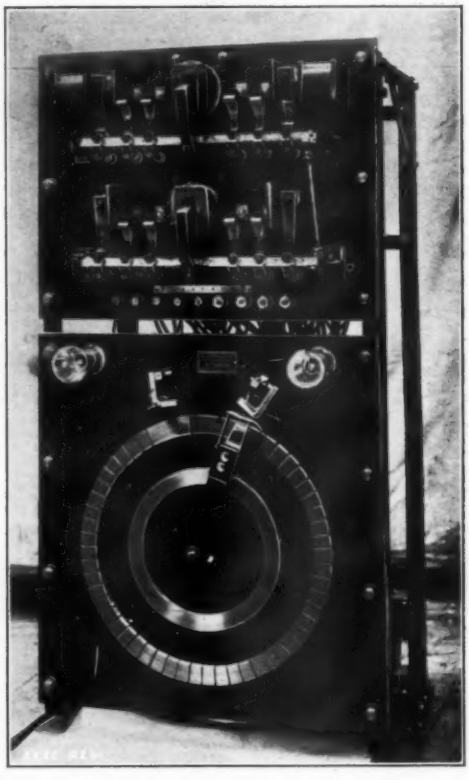


Fig. 11.—Motor-operated Dimmer.

amp. "Igranic" clapper switch is also connected across the dimmer, in order to obtain instantaneous "black outs" or "full light" for special effects. For the Queen's Road front, a flood-lighting scheme was worked out in conjunction with Mr. W. E. Bush, of the British Thomson-Houston Co., Ltd. (see fig. 9).

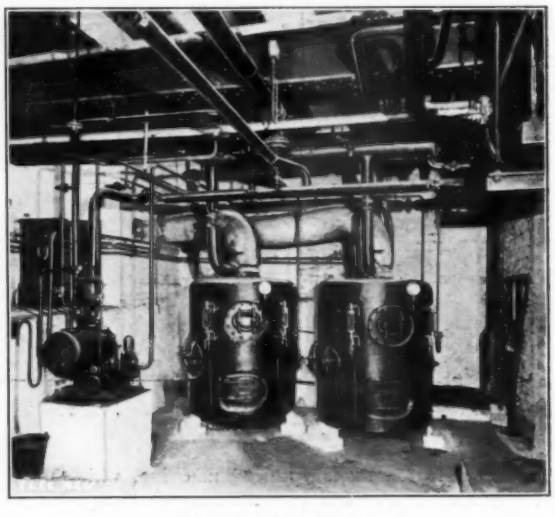


Fig. 12.—Steam Boilers.

Small 5-watt "Neon" lamps have been extensively used for decorative effect in torch globe brackets, and Ediswan "Fullolite" lamps have proved extremely

effective, used in conjunction with "Curtis" reflectors, supplied by the B.T.H. Co., Ltd., when mounted on floor standards, designed for indirect lighting.

Five electric service lifts and one wine lift, supplied and erected by Messrs. W. J. Taite & Co., Ltd., Nottingham, connect the restaurants and cafés with the kitchen at the top and the wine cellars in the basement of the building, and a 10-cwt. goods lift, driven by a 10-b.h.p. motor, connects the kitchen with the goods entrance and timekeeper's office in Queen's Road. Provision has also been made for the installation of four electric passenger lifts, each rated for 24 cwt. and driven by a 20-b.h.p. motor, as and when the Winter Garden is completed.

Ventilation in a building of this character presents several interesting features. At present the air supply is provided for by one 65-in., single-inlet, double-discharge, centrifugal cased fan, supplied by Messrs. Davidson & Co., Ltd., of Belfast, rated for 50,000 cu. ft. per minute, but provision has been made for the installation of a duplicate fan and two spray-type filters at a later date. Separate fans are provided for floor and roof-exhaust, and a separate system extracts from the Queen's Road cafés, restaurant, service rooms, lavatories, &c. Altogether, the final fan and washer load will total approximately 75 b.h.p., and approximately 200 tons of fresh air will be supplied and exhausted from the building per hour.

Heating has been carried out on the low-pressure, hot-water system with forced circulation, as experience proves that this provides the flexible control necessary, due to the vagaries of our climate and the rapidly varying numbers in the audiences. Five separate and complete circuits have been arranged, and one 5-in. centrifugal pump, rated for 300 galls./min., driven by a 3-b.h.p. motor, is at present installed, with provision for a duplicate in the future. Automatic temperature control will be added later.

In the basement, parallel with the Windsor Street fuel bunkers, which are rated for 30 tons, three boilers of the low-pressure sectional cast-iron type, each rated for 1,000,000 B.th.u. (30 h.p. equiv. rating), are now in operation, but provision has been made for extensions as and when the No. 2 plenum fan is installed and the Winter Garden is completed (see fig. 10).

Steam at 5 lb. per sq. in. for cooking and hot-water supply is obtained through reducing valves from two Spencer-Bonecourt squat type vertical boilers working at 100 lb. per sq. in., and rated for 1,000 lb. evaporation per hour on natural draught (fig. 12). A 4-in. x 2½ A x 5 in. double-acting, horizontal feed pump of the automatic type is connected to the condenser main, and as the clean condensate is returned from the hot plates, calorifiers, &c., a float valve admits steam to the cylinder and automatically returns the condensate to the boiler. A "Permutit" type water softener, supplied by United Water Softeners, Ltd., rated for 500 gallons per hour, has been put down to handle the boiler make-up and for the cold feed to the 400-gallon calorifier for the hot-water supply system to kitchens, service rooms, lavatories, &c., to which 50 draw-off points are connected. The rapid removal of dust and dirt, in a sanitary manner, is an important function of kinema and restaurant maintenance. A central system has been installed, operating at 7 in. (mercury) vacuum, rated for four renovators driven by an 8-b.h.p. motor, and connected to 25 hose cocks located at convenient points throughout the building.

The organ, erected at a cost of £8,000, is, in two portions, concealed above the stage boxes, and is played from a console (key-board) located in the orchestra well. To ensure instant and synchronous response from the two halves of the organ, electro-pneumatic control was adopted, which involved the use of many hundreds of delicate electrically-operated relays. The wind is supplied by a compound (high and low-pressure) centrifugal fan equipment, driven by a 7½-b.h.p. motor, a special 12-volt, 15-amp. generator and storage battery being included to operate the electro-pneumatic relays.

Communication between the principal points in the building is obtained by seventeen G.P.O. telephone extensions, connected to a central exchange located in the Queen's Road entrance, which, under any circumstances, had to be in the continual charge of an operator.

Fire protection is secured by a 4-inch wrought-iron ring main, connected by 3-inch risers to six hydrants, each equipped with 50 ft. of 2½-in. hose.

Messrs. W. J. Furse & Co., Ltd., Nottingham, and Messrs. John Jeffreys & Co., Ltd., of London, were the contractors respectively for the electrical and for the mechanical equipment; their excellent organisation and attention to details largely contributed to the successful completion and operation of the scheme in record time in spite of the many difficulties which arose from time to time.

In conclusion, our thanks are due to Mr. Ronald Grierson, A.M.I.E.E., A.M.I.Mech.E., for affording us facilities for the preparation of this article. As engineer to the Provincial Cinematograph Theatres, Ltd., Mr. Grierson has acquired unrivalled experience in the lay-out of the engineering equipment of kinemas, as well as in the technicalities of optical projection; he was responsible for the whole of the engineering installations of "The Regent," and, as will be gathered from the foregoing particulars, he has made excellent use of the unique opportunity which it offered for the execution of a comprehensive scheme on the most up-to-date lines.

LIGHTING AND POWER NOTES.

(Continued from page 88.)

Carlisle.—EXTENSIONS SANCTIONED.—The Electricity Commissioners have sanctioned the installation of an additional 3,000-kW turbo-alternator and accessories at an estimated cost of £35,500. Sanction is being sought to borrow a further £3,000 for services.

Crieff.—ELECTRICITY ORDER.—Application has been made for a Special Electricity Order by the Town Council. An Electricity Committee has been formed in anticipation of the receipt of the Order.

Deal.—FORMATION OF SUPPLY COMPANY.—The Town Council has decided to offer no opposition to a company about to be formed to supply electricity to the town, in the event of the necessary powers being obtained, and not to apply themselves for an Order. At present, powers to supply electricity are held by the Gas Company.

Dundee.—BULK SUPPLY INQUIRY.—The Electricity Committee has appointed its chairman and general manager to negotiate with the Grampian Hydro-Electric Syndicate as to the price of bulk supplies to the Dundee district and to report as to whether the Grampian Power Bill should be opposed or not. Approval was also given to the acceptance of contracts for £40,000 for sub-station equipment.

Eastbourne.—PREPAYMENT SYSTEM.—The Electricity Committee has received a petition signed by a number of consumers asking for the institution of a prepayment lighting system, which, it is suggested, would increase consumption while reducing the cost to individual consumers.

EXTENSION OF SUPPLY.—The Electricity Committee has under consideration a proposal to supply electricity to Westham. The estimated cost is £6,000.

Hove.—YEAR'S WORKING.—The total revenue of the Corporation electricity undertaking for the year ended March 31st, 1921, amounted to £39,763, as compared with £31,436 in the previous year. Working expenses were £25,763, as against £17,060, leaving a gross profit of £14,000 (£14,376). The result, after payment of capital charges, &c., was a net profit of £2,595; the previous year's profit was £3,920. There was a net profit of £34 on the Aldrington section, in which a bulk supply from the Brighton undertaking is distributed. In this section a deficit of £1,223 was incurred in 1919-20.

Inverurie.—PROPOSED ELECTRIC LIGHTING.—The Town Council has decided to ascertain the cost of an electric lighting installation, and at the same time to ask the Aberdeen Corporation its terms for supplying electricity to the town.

Lancashire.—LARGE-SCALE ELECTRIFICATION.—The linking-up agreements which are being arranged by Blackburn, Preston, and Accrington are designed to effect the electrification of a populous and important area of Lancashire. In the district within the areas of the municipalities concerned there are about 700 cotton mills and a population of over a million. Large expenditure is involved, it being estimated that the cost of a linking-up cable between Blackburn and Preston will alone be £138,000.

Lewes.—SCALE OF CHARGES.—The Electric Supply Co., Ltd., has applied for an Order authorising it to charge a minimum payment of 17s. 6d. for each winter quarter, and 1s. 2d. per unit for over 15 units consumed, and 11s. 8d. for each summer quarter, with 1s. 2d. per unit for over 10 units. Authority is also sought to cancel the agreement with the Town Council as to the price of electricity supplied to it.

Liverpool.—LOANS SANCTIONED.—The Electric Power and Lighting Committee has received the sanction of the Electricity Commissioners to the borrowing of the sum of £21,782 for the provision of mains, services and sub-station building and equipment in connection with the supply of electricity to the Springwood Estate housing scheme, Garston, and £100,000 for the provision of mains.

London.—REVOCATION OF COMPANY'S ORDER.—The Minister of Transport has ordered that the North Metropolitan Electricity (Temporary Increase of Charges) Order, 1920, be revoked with effect as from December 31st, 1921.

FULHAM.—The Electricity Committee recommends the provision of a sub-station, cables, and switchgear, at the cost of £2,000, for a supply of electricity to the works of the Manbre Sugar and Malt, Ltd. The supply will be about 300 kW, and a minimum revenue of £1,000 per annum for five years is guaranteed.

Londonderry.—YEAR'S WORKING.—The accounts of the municipal electricity undertaking (Engineer: Mr. R. V. Macrory) for the last complete financial year show a total revenue of £59,041 and a net profit of £5,759. The output was about 4,600,000 kWh. During the year charges for electricity for all purposes were reduced, making them by far the lowest in Ireland. The average selling price was 3.7d. per kWh.

Lytham.—PRICE INCREASE REFUSED.—The Electricity Commissioners have notified the Urban District Council that they cannot entertain the application to increase the maximum price which may be charged for electricity under the Lytham Electric Lighting Order, 1913.

Middlesbrough.—LOAN.—The Borough Council is making application to the Electricity Commissioners for sanction to borrow £6,000 for a sub-station and services in the Southfield Road and Linthorpe districts.

North of Scotland.—ELECTRICITY SUPPLY SCHEMES.—Messrs. Buchan Partners, consulting engineers, Edinburgh, have prepared a report on electricity supply in the North of Scotland. The engineers divide the districts as follows, showing the possible demand:—Banffshire districts, about 2,500 h.p.; Aberdeenshire districts of Huntly and Turriff, 1,600 h.p.; Morayshire districts of Burghead, Elgin, Fochabers, Forres, Lossiemouth, and Rothes, about 1,300 h.p. They are of opinion that a water-power scheme should be looked for to develop from 5,000 to 10,000 h.p. They outline two possible River Spey schemes, one of which they consider too expensive. The other, by a tunnel line from Blacksboat to Carron, will develop from 5,000 to 10,000 h.p. at an estimated cost of £300,000. Another £100,000 for storage works would give a generating cost at the power station of 1.4d. per unit. For high-pressure mains from a power house at Carron to Keith, thence to Buckie along the coast to Banff, Macduff, Turriff, Huntly and back to Keith, they estimate £160,000. The average selling price to consumers would be below 4d. per unit. The engineers recommend further investigation to reduce the cost of the Spey scheme, also that Aberdeenshire be asked if it would join Banffshire for a bulk supply.

Portsmouth.—LOANS SANCTIONED.—The Town Council has received sanction to loans of £30,000 for mains and services, £6,272 for services, and £6,000 for transformers and sub-station equipment.

Richmond-on-Thames.—PRICE INCREASE.—The Town Council General Purposes Committee's recommendation has been carried authorising the Richmond Electric Light Co. to charge not more than 7½d. per kWh for lighting (present price 6d. per kWh) up to 100 kWh per quarter and 7d. beyond; for power purposes the charge is to remain at 3½d., but for heating (2d. per kWh) no maximum price was fixed, and the meter charge also remains unaltered. The company obtains its electricity from the Lot's Road power station in bulk, and last year made a gross profit of £1,700. The revised scale was agreed to for five years, subject to either side calling for arbitration or agreement after 2½ years.—*Richmond and Twickenham Times.*

Sidmouth.—PROPOSED ELECTRICITY SUPPLY.—At a meeting of the Urban Council on January 11th, the chairman reported on an interview with a representative of Messrs. Gilbert Gilkes and Co., when he learned that a scheme of electricity supply would cost approximately £10,000. This was a saving of £15,000 on the scheme presented two years ago. The Council decided to meet Messrs. Gilkes's engineer and consider the question with him.

Southport.—CAUSES OF BREAKDOWNS.—The municipal buildings were suddenly deprived of light recently. Upon investigation it was found that a rat had short-circuited a transformer. A short time before this a failure of supply had been caused by a cat in a similar manner.

St. Annes.—LOAN.—The Urban District Council is applying to the Electricity Commissioners for a loan of £31,000 for electricity purposes, the largest item being £14,000 in respect of new and supplementary mains.

Stafford.—LOAN.—The Electricity Committee is applying to the Electricity Commissioners for sanction to borrow £10,000 for a new boiler and auxiliary plant.

Stonehaven.—PROPOSED ELECTRICITY SCHEME.—The Town Council is considering a scheme for the electric lighting of the burgh, and the Lighting Committee has been asked to inquire and report. An engineer suggests three schemes for consideration: a supply from Aberdeen; the possibility of obtaining power from water sources; or the erection of plant.

Stretford.—NEW GENERATING SET.—A new Metropolitan-Vickers 5,000-kW turbo-generator set was started up on January 9th by the chairman of the Electricity Committee.

Swadlincote.—BULK SUPPLY REQUIRED.—The Burton-on-Trent Corporation having asked for the consent of the Urban Council to place an overhead transmission line and an underground cable in the urban area, the Council has decided to ask the Corporation whether it is prepared to supply electricity in bulk to the town.

Wakefield.—LOAN.—The City Council is applying to the Electricity Commissioners for sanction to borrow £10,000, principally for mains extensions.

Westgate-on-Sea.—ELECTRICITY SUPPLY.—The Council has asked the Gas Co. whether it will supply electricity to the town. If not, the Isle of Thanet Tramway Co. is to be asked if it is prepared to extend its cables to Westgate.

Whitehaven.—LOAN.—The Town Council has applied for sanction to borrow £3,500 for the extension of electrical services at Arrowthwaite, Thwaiteville, and in conection with the Bransty housing scheme.

Widnes.—OVERHEAD WIRES.—The Corporation has refused the application by the Mersey Power Co. for permission to erect overhead wires in the Appleton district of Widnes.

Worcester.—ELECTRICITY FOR NEW HOUSES.—The Town Council has decided to install electric lighting in the houses being erected in Bromyard Road.

TRAMWAY AND RAILWAY NOTES.

Blackburn.—PARLIAMENTARY BILL.—A statutory meeting of the Council was held on January 9th to confirm a Parliamentary Bill giving the Corporation certain powers. The Bill provides for extensions to the tramway system and for the running of motor omnibuses both inside and outside the borough. A sum of £268,823 will be required to meet the cost of the tramway extensions and the omnibus service. This clause was opposed by the Commercial Motor Users' Association and the East Lancs. Road Transport Association. In the end the clause dealing with motor omnibuses was defeated by an overwhelming majority. This necessitates a special poll of the ratepayers.

Edinburgh.—TRAMWAY ELECTRIFICATION.—The Town Council, after reversing its decision to have span wire supports for the electric tramway wires, has decided to apply to the Minister of Transport for sanction to erect central poles in Princes Street.

Farnworth.—LINKING-UP SYSTEMS.—At a meeting of the Council on January 11th it was reported that the Farnworth and Kearsley Councils had waited on Salford Corporation regarding the linking-up of the tramways between Bolton and Manchester by providing a short length at Clifton. There was not much hope entertained of this link being supplied for the present. The Salford lease of the Swinton line would expire in four years and the short length of tramway, costing £5,000, would then have to be handed over to the Swinton Council.

Glasgow.—PURCHASE OF PAISLEY SYSTEM.—At a meeting of the Town Council on January 5th a proposal of the Tramways Committee to offer £200,000 was discussed. There was a general feeling that more information should be given regarding the matter, and the proposal was therefore referred back to committee.

Jamaica.—ACQUISITION OF TRAMWAYS.—It is announced in Jamaica that the Canadian Pacific Railway is likely to acquire the tramway service operated in Kingston and district by the West India Electric Co., Ltd., another Canadian concern, with headquarters at Montreal. The C.P.R. is also said to be willing to take over the Jamaica Government Railway for a term of years and to pay the colony in return a certain sum annually, in addition to meeting interest and sinking fund charges on the existing railway loans.—*The Times Trade Supplement.*

London.—LATE "TUBE" TRAINS.—After experiments extending over a period of two months, the Underground Railway Companies have come to the conclusion that the special late trains are not sufficiently used to justify their continuance. They are accordingly to be withdrawn.

ADDITIONAL "TUBE" ACCOMMODATION.—To cope with the extra flow of traffic during the "rush hours," four additional six-car trains have been put into service in the Piccadilly line as from Monday last. Accommodation for an extra 2,400 passengers is made available by this means.

EFFECTS OF SNOWSTORM.—The parts of London's electric railways exposed to the air were affected by the snowstorm on January 15th. Steam-driven snow-ploughs and brushes were brought into use and considerably reduced the number of stoppages and loss of time. On the London & North-Western suburban lines a special steam-train service was run.

NEW "THROUGH" ROUTE.—On January 22nd the L.C.C. is instituting a direct tramway route from Chelsea to Southwark Bridge—a distance of nine miles—*via* Clapham, Stockwell, Brixton, and Camberwell Green.

Prestonpans.—ACCIDENT.—On January 12th a tramcar proceeding from Crown Square to Prestonlinks pit encountered a drift of sand on the track and was derailed. It came into contact with an iron standard, smashing the front of the car and the windows. The driver escaped with slight injuries; several passengers sustained shock and bruises.

Rochdale.—L. & N.W. RAILWAY ELECTRIFICATION.—The Town Council has been informed that it is improbable that the electrification of the L. & N.W. Railway service between Manchester and Oldham will be continued from Oldham to Rochdale at the commencement of the scheme.

Taunton.—TRAMWAY SERVICE.—At a recent meeting of the Town Council a resolution was adopted urging the re-opening of negotiations with the Taunton Electric Traction Co., Ltd., with a view to the transfer of the system to the municipality. The absence of the tramcars is being felt very severely.

Wolverhampton.—PROPOSED REVISION OF FARES.—It was stated at a recent Council meeting that the cars were running in a half-empty condition and plant was lying idle. The Tramways Committee was therefore instructed to carefully consider what economies could be effected in the working expenses, and whether lower fares for shorter stages would not result in a greater number of passengers being carried, without detriment to the gross receipts, and to report to the Council at the earliest possible date.

TELEGRAPH AND TELEPHONE NOTES.

Belgium.—NEW WIRELESS STATION.—The Belgian Government has just placed the contract for the big international wireless station of Ruysselede, near Bruges. The new station will be the biggest of its kind in Belgium, and in some points will excel any station in France or elsewhere. The antennæ will spread 1,200 metres in length and 400 metres in breadth, and will be upheld by eight standards 275 metres high rigged on a new system. The equipment will consist of an arc generator and a high-frequency alternator. It is planned for an automatic daily transmission of 60,000 words, in order to serve the traffic to North and South America and the Congo. The receiving centre will be situated at Bruges, and will comprise several complete sets of plant, in order to allow of the simultaneous receipt of at least four different messages during the working of the sending post. The Belgian station will have a power in the antennæ of 500 kW, as at Croix d'Hins, but the effective height will be 30 metres greater than the latter, while the current in the antennæ will reach 650 amperes, and the useful working range will be threefold greater. The lengths of wave realised, both with the arc and the alternator, will be about 20,000 and 25,000 metres. The contract has been secured by the Société Indépendente Belge de Télégraphie sans Fils, against competition, both from firms in Belgium and abroad.

The power required to work this station will be 1,000 kW.

Kenya Colony.—TELEGRAPH SERVICE.—An overhead telegraph service has been established between Mombasa and Cape Town *via* Tanganyika Territory, Nyassaland, and Rhodesia. The rates are cheaper than by the sea cables, says *The Times*.

Storm Damage.—During the Mediterranean storm of last week telegraphic communication between France and Morocco was maintained by aeroplanes. The cable broke down and ships were greatly delayed by the heavy seas. Conveyed by aeroplane from Casablanca, 600 telegrams were delivered the following day at Toulouse.

The Post Office announced on the 13th inst. that owing to cable interruptions heavy delays were to be expected in the transmission of messages to Scandinavia and Finland.—*Daily Mail*.

According to the *Manchester Guardian* Mid-Wales was snowbound on Saturday last by the blizzard which swept over it during the night. Telegraphic and telephonic communication generally was seriously interrupted, and in some cases completely suspended. Many overhead wires were down in Kent.

The Central Telegraph Office reported that owing to the severe snowstorm, followed by a thaw, communication with Paris was much interrupted.

The Telephone Service.—NEW TRUNK CABLE COMPLETED.—The new underground cable, says the *Manchester Guardian*, has now been laid between Liverpool and Manchester, and will afford "additional channels of communication between Liverpool and a large number of Lancashire towns, of which Manchester is the principal switching centre." The greatest benefit of the additional circuits will be felt in Manchester itself. The new cable will improve communication also with North Wales. The cable is loaded at intervals of about 1¼ miles, and consists of 160 pairs of copper wires, each weighing 40 lb. to the mile. It is 36¼ miles long, and the connecting up of the comparatively short lengths in which it had to be drawn into the ducts required 160,000 soldered joints, each electrically tested. Its speaking efficiency is equivalent to that of a standard telephone cable nine miles in length. The total number of trunk circuits between Manchester and Liverpool is now 333. A cable is also being laid between Manchester and London, and work has been begun on another connecting Birmingham and Manchester—the placing of the contract having been expedited to relieve unemployment.

PRIVATE AUTOMATIC EXCHANGE.—Sir William Noble, engineer-in-chief to the British Post Office, on January 16th opened at the head offices of *The Liverpool Courier and Express* a new automatic telephone exchange, linked up with the public service, which has been laid down for the use of those newspapers. This is the pioneer installation of its kind for newspapers.—*Financial News*.

Wireless Telegraphy.—A WIRELESS CLUB FOR EAST HAM.—Mr. Ernest E. Forrest, 66, Gillett Avenue, East Ham, E., is endeavouring to form a wireless telegraph club in the East Ham, Forest Gate, and Barking districts. Wireless amateurs who desire to listen to the wireless concerts sent out from the Hague are informed by the agents of the Nederlandsche Radio-Industrie that the transmission times are on Sunday afternoons from 2 p.m. to 6 p.m.

AMATEUR TESTS.—The first prize in the recent Transatlantic amateur wireless tests has been won by the Manchester Wireless Society. The receiving set used in the test was erected at the residence of Mr. W. R. Burne, Springfield, Thorold Grove, Sale, who was responsible for the manipulation of the various instruments loaned to him by members of the Society. These instruments, together with the special panel built for the occasion by Mr. Burne himself, enabled the tests to be carried through successfully. The receiving set will be exhibited on February 25th at the Society's headquarters, the Albion Hotel, Piccadilly.—*Manchester Guardian*.

CONTRACTS OPEN AND CLOSED.

(The date given in parenthesis at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Accrington.—Corporation. One 6,000-kW turbo-alternator with condensing plant. (See this issue.)

Australia.—MELBOURNE.—February 20th. City Council. Electricity Department. One rotary converter with transformer, &c.; 6,600 V switchgear. (City Electrical Engineer.)

Victorian Railway Commissioners. March 8th. 35 cabin transformers for power signalling. (Contract No. 34,863.)*

P.M.G.'s Department. March 8th. Switchboard apparatus and parts. (Sched. 545.) March 15th. Protective apparatus (Sched. 546).

SYDNEY.—April 24th. Electricity Department. Two 2,000-kW rotary converters, and one 10,000 to 12,000-kW turbo-alternator.*

Aylesbury.—Electricity Department. One 300-kW converter, with e.h.p. and l.p. switchgear. (January 6th.)

Bulgaria.—SOFIA.—February 14th. Department of Posts, Telegraphs and Telephones. Bronze in plates and bars, iron and steel plates and bars, and insulating materials.*

February 27th. Various electrician's small tools (including pincers, brazing lamps, soldering irons, bits, &c.).*

March 8th. Porcelain insulating tubes for telephones, impregnated paper insulating tubing, ebonite cap, and insulated copper wire.*

Egypt.—ALEXANDRIA.—April 25th. Municipal Council. Supply and installation of pumps and motors at the Kait Bey principal pumping station.—*Reuter's Trade Service* (Cairo).

Italy.—ROME.—April 30th. Italian State Railways. Electrification of the Bologna-Montfalcone Line. Particulars from Direzione Generale Ferrovie dello Stato, Rome.

London.—LEWISHAM.—January 23rd. Board of Guardians. Electrical installation at the Children's Home, Cumberlow, Goat House Bridge, Norwood Junction, S.E. (January 13th.)

ISLINGTON.—February 16th. Electricity Department. Electrical and engineers' stores for 12 months, including cables, meters, lamps, wires, carbons, engine-room stores, &c. (January 13th.)

HAMMERSMITH.—January 25th. Electricity Department. Supply, drawing-in and jointing, &c., an additional 11,000-V, three-phase linking-up main between the Fulham and Hammersmith electricity generating stations. (January 13th.)

New Zealand. — WELLINGTON.—February 24th. Public Works Department. Three 11,000-V reactances complete, for the Lake Coleridge electric power scheme.*

DUNEDIN.—March 31st. City Council. One 150-h.p. 3-phase induction motor and reduction gear.*

AUCKLAND.—Auckland Electric Tramways Co. February 20th. Permanent way material. March 20th. Overhead line material. Specifications may be inspected at the offices of the British Electrical Federation after February 1st.—*Reuter's Trade Service* (Auckland).

Portlaoighise.—February 8th. District Mental Hospital. Supply of 55 complete renewal sections for 33 plate, B.N. type, Sandycroft battery. (See this issue.)

Warrington.—February 6th. Electricity Department. Main e.h.p. switchboard extension. (January 13th.)

*A copy of the plan, specifications, and conditions of tender, &c., can be inspected at the Department of Overseas Trade (Room 84), 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—Melbourne City Council. Accepted:—
14 tons bare h.d. copper cables, £2,064.—British Insulated & Helsby Cables, Ltd.
3,000 500-watt lamps, £1,212.—Lawrence & Hanson.
300 400-watt and 500 300-watt lamps, £338.—Australian General Electric Co.
6,600 V switchgear, £1,504.—Metropolitan-Vickers Electrical Co., Ltd.
Switchgear protection relays.—Ferguson, Pailin & Co., Ltd.—*Tenders.*

Belgium.—Eight firms submitted tenders last week to the Belgian Post and Telegraph Authorities in Brussels for 63 cable heads. Among the firms tendering was W. T. Henley's Telegraph Works Co., Ltd., the lowest offer being that of a Belgian concern, F. Lemoine, of Dison.

Blackpool.—Electricity Committee. Recommended, subject to the sanction of the Electricity Commissioners:—
5,000-kW turbo-alternator.—Fraser & Chalmers, Ltd.
Condenser and auxiliaries.—Hick, Hargreaves & Co., Ltd.

Leigh.—Board of Guardians. Accepted:—
Jas. Morris, Bolton, £340 for the installation of electric lighting at the hospital, master's rooms, board room, and offices.

Peterborough.—Board of Guardians. Accepted:—
W. H. Borrows, of Warrington, for installing electric light at the Workhouse, at £240. Other tenders submitted were:—Messrs. Hanson, £235; J. Towle & Son, £265; N. Mayner, £255; G. Andrews and Co., £255; A. S. Sharp, £246.

South Staffordshire.—MESSRS. GLENFIELD & KENNEDY, LTD., of Kilmarnock, have received an order for a large pumping engine from the South Staffordshire Waterworks Co., Birmingham, for its pumping station at Slade Heath. The contract includes a complete electric lighting plant for the pumping station.

Sunderland.—Town Council. Accepted:—
British Insulated & Helsby Cables, Ltd.—Cable.
Ferranti, Ltd.—Meters.

FORTHCOMING EVENTS.

Salford Technical & Engineering Association.—Saturday, January 21st. At the Royal Technical College. At 7 p.m. Presidential address by Mr. J. Morris, and musical social evening.

Manchester Wireless Society.—Saturday, January 21st. At the Albion Hotel. At 8 p.m. Whist drive and dance.
Thursday, January 26th. At 7.30 p.m. Practical demonstrations and exhibition of wireless apparatus.

Institution of Electrical Engineers.—INFORMAL MEETING. Monday, January 23rd. At the Institution, Victoria Embankment. At 7 p.m. Discussion on "Electrical Vehicles, Present and Future," to be opened by Mr. R. J. Mitchell.

(North-Eastern Centre).—Monday, January 23rd. At the Armstrong College, Newcastle-on-Tyne. At 7.15 p.m. Paper on "The Interconnection of A.C. Power Stations," by Messrs. L. J. Romero and J. B. Palmer.

(North-Western Centre).—Tuesday, January 24th. At the Engineers' Club, Manchester. At 7 p.m. Paper on "The Cyc-arc Process of Automatic Electric Welding," by Mr. L. H. Steele and Mr. H. Martin.

(East Midland Sub-Centre).—Tuesday, January 24th. At the Loughborough College At 6.45 p.m. Paper on "Loughborough Electricity Undertaking and Extensions in Hand," by Mr. R. B. Leach.

(Tees-side Sub-Centre).—Thursday, January 26th. At the Cleveland Technical Institute, Middlesbrough. At 7 p.m. Paper on "Methods of Conversion of A.C. to D.C. for Traction Purposes," by Mr. C. H. Davidson.

(Irish Centre, Dublin).—Friday, January 27th. At the Royal College of Science, Dublin. At 8 p.m. Lecture on "The Development of Electricity Supply in Switzerland," by Mr. E. M. Johnson.

(London Students' Section).—Friday, January 27th. At 7.45 p.m. Theatre party at Coliseum. Tickets 3s. 6d. each.

Institution of Civil Engineers.—Tuesday, January 24th. At the Institution, Great George Street, S.W. At 6 p.m. Discussions on papers, "Control of Trains in Relation to Increased Weight and Speed Combined with Reduced Headway," and on "Trials in Connection with the Application of the Vacuum Brake for Long Freight Trains."
Students' Meeting.—Wednesday, January 25th. At the Institution, Great George Street, S.W. At 6 p.m. Second lecture on "The Economic Aspects of Various Methods of Power Transmission," by Mr. E. W. Monkhouse.

Women's Engineering Society.—Tuesday, January 24th. At 26, George Street, Hanover Square, W. At 6.15 p.m. Lecture on "Domestic Engineering," by Miss Gwynne Howell.

Industrial League and Council.—Wednesday, January 25th. At Caxton Hall, S.W. At 7.30 p.m. Lecture on "Conditions of Industrial Harmony," by Mr. F Hughes.

Chelmsford Engineering Society.—Thursday, January 26th. At the East Anglian Institute. At 7 p.m. Paper on "The Reclamation and Utilisation of Waste in Factories," by Mr. G. H. Ayres.

Junior Institution of Engineers.—Friday, January 27th. At Caxton Hall. At 8 p.m. Lecturette, "Fuels and the Boiler House," by Mr. L. M. Jockel.

Edinburgh Electrical Society.—Friday, January 27th. At the Philosophical Institute. At 8 p.m. Paper on "Some Notes on Country House Plant," by Mr. T. S. Munnoch.

Manchester Electro-Harmonic Society.—Friday, January 27th. At the Albion Hotel (Marble Hall). Concert.

Electrical Power Engineers' Association (Southern Division).—Friday, January 27th. At the Central Hall, Westminster. At 7 p.m. Lecture on "The Metering of Steam by Means of Orifices," by Mr. J. L. Hodgson.

Physical Society of London.—Friday, January 27th. At the Imperial College of Science, South Kensington, S.W. At 5 p.m. Ordinary meeting.

National Association of Supervising Electricians.—Saturday, January 28th. At Frascati's Restaurant, Oxford Street, W. At 6.30 p.m. Annual dinner and musical evening.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

To enable us to complete our replies to inquiries this week we need the names of manufacturers or suppliers of:—
"WITHNITT" insulators.
"AJAX" dry batteries.

NOTES.

Service Notes.—Lieut.-Com. G. McL. Cameron, Royal Navy, has been appointed to *Comus II.* for charge of the wireless station at Aden, one of the most important naval bases in the East. A large number of discharges are being made from the Electrical Department at Rosyth naval base, and, judging by inner knowledge, there is little chance of any abatement in the discharges for some time to come. Warrant Electrician J. Bryant has joined the battle-cruiser *Malaya* for service. Captain C. R. H. Thorn, T.D., M.I.E.E., has relinquished his commission in the London Electrical Engineers after a service extending back for nearly twenty years. On retiring from the Southern Signal Companies, Major A. Handley, M.I.E.E., has been given the rank of lieutenant-colonel.

Educational.—The Engineering Department of the University College, Nottingham, has arranged a course of lectures on the high-pressure transmission of electrical energy, the first of which was given on January 17th. Admission to the lectures is free.

The "Model Engineer" Exhibition.—The fifth *Model Engineer* small power, engineering, and scientific exhibition, that was held at the Royal Horticultural Hall last week marked the revival of a series of similar displays organised by Messrs. Percival Marshall & Co. Four previous shows have been held, the last taking place in 1913. Whether pursued as a hobby or as an aid to technical education or invention, the educational advantages of model building to the youthful engineer and technical student are too apparent to need emphasis.

The quality of the exhibits in the Competition Section clearly proved to be on as high a plane as ever, and showed talent for fine craftsmanship in metal. The models in this section came from all parts of the British Isles, and the competitors represented all grades of society. Some 9 out of the 148 models in this section were of electrical interest—namely, a valve receiver for wireless telegraphy and an air-core h.p. transformer, a high-speed vertical electric light engine, an electrically-propelled single-screw ship, an electric tank locomotive, a 4-cylinder petrol engine driving a Whitney dynamo, an undertype steam engine and dynamo, an electric torpedo boat destroyer, a 12-volt motor and 10-volt, 5-amp. dynamo, &c. On the stand of the Model Railway Club four electric locomotives were noticed, while the *Rattler* (a 3-ft. electric yacht, and the *Maud* (an electric tug boat), were shown by members of the South London Experimental and Power Boat Club.

This year a record number of trade firms (60) had exhibits on view, of which some 20 showed fractional h.p. motors, wireless apparatus, novelties, &c. Mention may be made of the ¼-kW petrol-electric lighting plant, with batteries, made by MESSRS. STUART TURNER, LTD.; of the small motors and sundries on the stand of the GENERAL ELECTRIC CO., LTD.; of the master clocks and horophones (wireless receiving) shown by the SYNCHRONOME CO., LTD.; and of the wireless devices and accessories shown by the MARCONI SCIENTIFIC INSTRUMENT CO., LTD. The official electricians to the exhibition were MESSRS. BROOKS & WHITE, and by good foresight the exhibition was arranged, as usual, to take place during the Christmas holidays, so that boys home from school would be able to go again and again—as they always do—to see, inspect, and explain to their elders just how the thing works. The fathers, as a rule, were just as keenly interested as their children.

The Electrical Wholesalers' Federation.—A dinner is to be held by this Federation at the Trocadero Restaurant on Thursday, February 2nd, at 7 p.m.

The Electro-Harmonic Society.—At the concert held at Cannon Street Hotel, on January 13th, Mr. William Peto acted as chairman, and a good programme was presented. Mr. Bernard Flanders, A.R.A.M., officiated at the piano; the vocalists were Mme. Ethel Dyer (soprano), Mr. Ernest Hargreaves (tenor), and Mr. Walter Sauli (baritone). The lighter side of the programme was provided by Messrs. Nelson Jackson, Sterndale Bennett, and Will Edwards. Mr. Charles Leggett and his cornet were well received.

Fatalities.—On January 3rd an inquest was held into the death of William Hawkes, an electrician in the employment of Messrs. Vickers, Ltd., Erith. It was stated that the deceased had received instructions to alter the connections in a cable dug-out, and a fellow electrician, going to the place shortly afterwards, found him grasping a cable and unconscious. Kicking the cable away, the witness said that he examined deceased and found him lifeless. Further evidence showed that the current in the circuit was at 200-V pressure. A juryman suggested that there had been neglect on the part of the firm in not sending a mate with deceased to the job, but it was pointed out that this was not usual in a minor operation of this nature. Mr. G. Scott Ram, Senior Electrical Inspector of Factories, was present, and said that the case would receive further attention. A verdict of "Death from misadventure" was recorded.

At the Phœnix works of the English Electric Co., Ltd., at Thornbury, Bradford, on January 13th, Lawrence Waterhouse (23), of Horsforth, an electrical engineering trainee under the Government scheme, was found dead on the test bed near a switchboard; it is surmised that he was engaged in making some adjustment on the board without having switched off the power, when he fell and struck a live wire carrying a current at 500 V.

The South-East Lancashire Electricity District.— THE LOCAL INQUIRY.—The inquiry by the Electricity Commissioners into the scheme for the improvement of the organisation for the supply of electricity in South-East Lancashire, was opened at the Town Hall, Manchester on Tuesday last, before Sir John Snell (chairman), Sir Harry Haward, Mr. H. Booth, and Mr. W. Lackie. Mr. Tyldesley Jones, K.C., and Mr. Burgis appeared for the promoters who are the conference of authorised undertakings in the area.

In his opening address, Mr. Tyldesley Jones said the area extended to Wigan on the west, and Macclesfield on the south, and included the towns of Ashton, Bolton, Bury, Oldham, and Rochdale.* The population numbered 2,729,263, the rateable value £15,779,646, and it contained nearly ten per cent. of all the electricity generating plant in the United Kingdom. The only undertakings within that area which he did not represent were the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board, and the Yorkshire Electric Power Co.

It was found impossible to come to an agreement for the constitution of a Joint Electricity Authority, and the alternative was a Joint Advisory Board which was the scheme now presented.† The Board would consist of 48 members. Its function would be to see that no new generating station was built, nor an existing one extended, without the proposals being first submitted to the Board, which might be able to formulate an alternative scheme more conducive to the general interests.

Mr. Eastham, representing the Stalybridge Board, asked what would happen if the constituent authority and the Board did not agree.

Mr. Tyldesley Jones replied that the constituent authority would be heard, and if dissatisfied it could appeal to the Commissioners.

A discussion of this point ended with a suggestion that the scheme when approved might embody the powers conferred by section 19 of the Act.

Alderman Dagnall, chairman of the Manchester Electricity Committee, was the first witness called. He said the scheme put forward had received practically unanimous approval. The Stalybridge Board did not object to it, but asked to be excluded. In cross-examination by Mr. Eastham, he agreed that it could only be carried out with the goodwill and co-operation of all the undertakers. The Board would be acquainted with what was going on and would advise the various authorities in the interests of the whole. It was not contemplated that the Board should receive complaints by people who felt they had a grievance by reason of the defective nature of the supply or the want of extensions.

Mr. S. L. Pearce, chief engineer and general manager of the Electricity Department of the Manchester Corporation, said a very detailed *questionnaire* was submitted to the undertakers, and from the information so gathered, statistics were prepared. After considering those, the conference of undertakers came to the definite conclusion that an improvement of the supply over the whole area was desirable. Originally it was estimated that the scheme would effect by 1925 an annual saving of the order of £175,000, and five years later of £253,000, but the price of coal had dropped substantially since then, and the revised figures ,based upon 20s. per ton for coal instead of 35s., showed an annual saving of £103,000 by 1925, and £153,000 by 1930. The reduction was in capital costs and coal. It was very difficult to say what saving there would be in labour. There had been a material reduction in the load factor owing to the decrease in the working hours. The conditions of industry in the district had been extremely bad during the last twelve months, and he did not think the load factor would drop any more.

The inquiry was continued on the following day, and will be reported in our next issue.

* ELEC. REV., June 25th, 1920; p. 815.
† ELEC. REV., Sept. 30th, p. 454; and Nov. 4th, p. 596, 1921.

The Manchester Electro-Harmonic.—Readers in the Manchester district, and those everywhere else who may be contemplating a visit to that great centre next week, would do well to take note that the Manchester Electro-Harmonic Society is holding its next concert on Friday, January 27th, in the Marble Hall at the Albion Hotel, Piccadilly, Manchester. The chair will be taken by Mr. J. A. Robertson, M.I.E.E., borough electrical engineer of Salford, and the artistes will be: soprano, Miss Pansy Moore, L.R.A.M., A.R.C.M.; baritone, Mr. James Frost; entertainers, Mr. John Graham and Mr. Essler Kessen. We hope that there will be quite a large gathering on this occasion to do justice to the programme that has been prepared and to encourage those who have spared no effort to make the Manchester Electro-Harmonic movement a success.

The Women's Engineering Society.—Among a series of lectures arranged by the Society is one on "Domestic Engineering," by Miss Mary Gwynne Howell, which will be delivered at the Club Room, 26, George Street, Hanover Square, W., on the evening of January 24th. All men and women who are interested may obtain tickets from the Secretary at the address given above.

Appointments Vacant.—Chief electrical engineer (£700+ £250, approximately) for the City of Hereford; three telephone engineers (Rs.750 per month) for the Government of India; engineering assistant for the Worcester Corporation Electricity Department. (See advertisements in this issue.)

INSTITUTION NOTES.

The Institution of Electrical Engineers.—MEMBERSHIP OVER 10,000.—At last week's meeting of the Institution the President announced that the total membership now exceeded 10,000.

INFORMAL MEETINGS SECTION.—At the meeting of the informal Section on Monday, January 9th, Mr. A. B. Eason was in the chair, and Mr. J. W. Beauchamp opened a discussion on "Co-operative Advertising." Probably because it was not a technical subject there was not quite so large a gathering as usual, but the paper was particularly interesting and of the first importance, not only to the commercial side, but to all branches of electrical engineering. Mr. Beauchamp showed how collective advertising by an industry prepared the public for the advertisements of individual manufacturers in that industry. He outlined the activities of the Electrical Development Association, which was founded only 2½ years ago, and is already so firmly established. He showed and criticised a number of lantern slides reproducing various advertisements. Then followed illustrations of attractive appeals and displays by electrical manufacturers, supply authorities, &c., among them the handsome showrooms of Toronto. The values of different advertising methods were discussed, and the different media of the technical and lay Press—town and provincial. A large number of speakers took part in the discussion, and Mr. Beauchamp, in his reply, summarised and dealt with the points brought out. He made a notable suggestion that great publicity and benefit would result if the various supply authorities could make a collective announcement of a standard price reduction on one date, instead of various reductions of, say, 5, 10, or 15 per cent. in the price of supply, between now and March.

DINNER.—Members will dine together informally at the Engineers' Club, London, after the meeting of the Institution on February 2nd. It is particularly requested that those proposing to dine should send their names beforehand to the secretary of the Institution. The charge will be 5s. 6d. per cover.

PROGRAMME.—The following are the arrangements for the remainder of the session, so far as the dates have been filled up:—

ORDINARY MEETINGS OF THE INSTITUTION.

Feb. 2nd.—L. J. Romero and J. B. Palmer. "The Interconnection of A.C. Power Stations."
Feb. 16th.—F. P. Whitaker. "Rotary Converters, with special reference to Railway Electrification."
Feb. 21st.—Annual Dinner. At the Hotel Cecil (7 for 7.30 p.m.).
Feb. 21st, 22nd and 23rd.—Meetings in commemoration of the first meeting of the Society of Telegraph Engineers held on February 28th, 1872. (Some particulars of the arrangements were announced in this column of January 6th.)
Mar. 2nd.—Discussion on "Starters," with introductory papers by:—
C. H. Wordingham, C.B.E. "The B.E.S.A. Specifications for Starters."
J. Anderson. "Electric Motor Starters."
W. Wilson, B.E., M.Sc. "Some Notes on the Design of Liquid Rheostats."
Mar. 16th.—J. G. Hill. "Phantom Telephone Circuits and Combined Telegraph and Telephone Circuits worked at Audio Frequencies."
Mar. 30th.—R. Borlase Matthews. "Applications of Electricity to Agriculture."
April 6th.—J. A. Kuyser. "Protective Apparatus for Turbo-Alternators."
April 27th.—Joint Meeting with the Electro-therapeutic Section of the Royal Society of Medicine and the Röntgen Society. Subjects of papers to be announced later.

May 11th.—Sir E. Rutherford, K.B.E., F.R.S. The Thirteenth Kelvin Lecture, "Electricity and Matter."
May 25th.—Annual General Meeting.

WIRELESS SECTIONAL MEETINGS.

Feb. 1st.—Major J. Erskine-Murray, R.A.F. (a) "The Determination of the Decrement of a Distant Sending Station," and (b) "Some New Methods of Radio-Navigation."

INFORMAL MEETINGS.

Jan. 23rd.—Discussion on "Electric Vehicles, Present and Future" (opened by Mr. R. J. Mitchell).
Feb. 6th.—Discussion on "Some Practical Applications of the Thermionic Valve" (opened by Mr. J. Joseph).
Feb. 20th.—Discussion on "The Emergency Use of Oil Fuel during the Recent Coal Strike" (opened by Mr. E. F. Hetherington).
Mar. 6th.—Discussion on "E.H.T. Cable-Testing" (opened by Mr. E. Ambrose).

WESTERN CENTRE.—At the meeting that is to be held at Cardiff on February 6th the president of the Institution (Mr. J. S. Highfield), will deliver an address. It is proposed to hold the annual dinner on the same evening if a sufficient number of members are willing to attend. The price will be approximately 12s. 6d. per head, excluding wines.

SCOTTISH CENTRE.—The third ordinary meeting of the Scottish Centre of the Institution was held at Edinburgh on January 10th, 1922, when Mr. L. H. A. Carr read his paper on "Induction-type Synchronous Motors." Mr. E. T. Goslin (chairman of the Section) presided. Mr. Carr read through his paper as published, and at the conclusion showed (by means of lantern slides) a variety of synchronous induction motors made by British and Continental firms. The rotors illustrated were of the single, 2 and 3-phase types, and starting gear of the contactor and controller types was also shown. The meeting was well attended and a discussion followed, which showed that the audience was chiefly interested in the question of tariff reductions which could be obtained by the use of power-factor correcting devices. One interesting point brought out was that a static condenser of 400 kVA capacity had been in use in Scotland for the past 15 years without giving the slightest trouble. The speaker who gave this information intimated his personal opinion that it would be extremely hard for any class of rotating power-factor-correcting device to compete with the static condenser.

Finsbury Technical College Old Students' Association.—The following officers have been elected for the present year: President, Mr. W. G. Head, M.I.Mech.E.; vice-presidents, Prof. G. T. Morgan, O.B.E., Mr. A. J. Chapman, F.I.C., Mr. F. H. Masters, O.B.E., and Mr. W. J. Tennant, M.I.Mech.E.; hon. treasurer, Mr. W. Bernard Thompson, A.M.I.E.E.; hon. secretary, Mr. H. P. Guy, A.M.I.E.E.

Institution of Mechanical Engineers.—A very interesting paper on electric arc welding in steel structures, illustrated by lantern slides, was read by Major James Caldwell, M.I.E.E., on January 10th at the first meeting, held at Swansea, of the recently-formed South Wales branch of the Institution. The chairman of the branch is Sir John Roper Wright, the vice-chairman Mr. David E. Roberts, and the joint hon. secretaries Mr. W. H. Reynolds, of Cardiff, and Professor F. Bacon, of Swansea University College. Half of the meetings are to be held at Swansea, and the other half at Cardiff.

Greenock Association of Electrical Engineers.—At a meeting held on January 11th, Mr. W. R. Gray, Greenock, dealt with the subject of X-ray apparatus. The lecturer, who has been engaged in the manufacture of this apparatus, gave some practical details of the various components. Lantern slides and a film (B.T.H.) entitled "Revelations of X-rays," showing modern apparatus in process of manufacture and in action, demonstrated the strides made in industrial and medical science.

Nottingham Society of Engineers.—At a meeting held on January 18th Mr. Arthur H. Barker, Wh.Sc., B.A., B.Sc., lectured upon "The Heating and Ventilation of Factories." The lecturer dealt with many aspects of the question, including safety, comfort of workers, economy, &c. Various methods of heating were discussed, including the use of waste heat.

Diesel Engine Users' Association.—At the December meeting of the Association, Mr. C. O. Milton, A.M.I.E.E., electrical engineer to the Borough of Maidenhead, was re-elected president for a second year, and Mr. Percy Still, M.I.E.E., M.I.P.T., was re-elected hon. secretary. Messrs. H. S. Whiteley and W. E. Brandreth were elected members of the general committee in place of the two members retiring at the end of their term of office. The hon. secretary made his annual statement which reported a further substantial increase in the membership of the Association during the year. By the courtesy of the Institution of Electrical Engineers the meetings are now again being held in the I.E.E. building. In view of the tendency in the design of pure Diesel engines to approach more nearly in some respects to the lines of semi-Diesel engine design, and *vice versa*, the president, in the course of one of the discussions, made the suggestion that it might possibly become advisable in the future to alter the name of the Association by adopting some such name as "The Heavy Oil Engine Users' Association."

South African Institution of Engineers.—The *Journal* states that the Institution has received an advance draft of a projected "Engineers' Private Bill, 1922, intended to provide for the Registration of Engineers in the Union of South Africa." The matter is receiving attention with a view to a report by the Council.

Chelmsford Engineering Society.—On January 12th, Mr. H. Church, M.C., A.M.I.E.E., read a paper on "Production Records," the reasons for them, the principles governing them, and their application. Stress was laid upon the necessity for detailed costs of component parts and upon the use to which such costs could be put, not only as a means of comparing the actual costs of different orders, but as valuable help to both the designer and the progress engineer. The discussion which followed was well supported by the works managers and organisers of the various firms in Chelmsford.

Edinburgh Electrical Society.—At a meeting held on January 15th a paper on "Storage Batteries as applied to Electric Traction" was delivered by Mr. L. Brookman. The lecturer traced the history of electrical traction in this country and America, and emphasised the rapid progress which had been made within the last few years. The characteristics of traction batteries were indicated and a thorough description of the "Exide" and "Ironclad Exide" cells was given. Attention was directed to the changes from normal patterns required in road batteries. Portability, resistance to scrubbing action, means for prevention of gassing and splashing were among the qualities mentioned as influencing the design of such cells. The great advantages of battery vehicles for many classes of road transport were enlarged upon.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

The Belfast Corporation met in Committee on the 12th inst. for the purpose of considering certain matters arising out of the minutes which were presented by the Electricity Committee at the monthly meeting on the 2nd inst. The Lord Mayor (Councillor, Sir William Coates, Bart., D.L.) presided. The minutes had reference to a report submitted by the City Electrical Engineer (Mr. T. W. Bloxam) with regard to a failure of the supply of electricity on the 9th December, and to a re-organisation scheme which had been prepared by him on the instructions of a sub-committee. Councillor Oswald Jamison, vice-chairman of the Electricity Committee, made a statement regarding the present position of the electricity undertaking. Councillor D. R. Campbell moved that a committee should be appointed to report on the re-organisation scheme and the position of the staff. Councillor C. Jamison moved an amendment, the effect of which was to create a vacancy in the position of City Electrical Engineer, and to grant to Mr. Bloxam, a pension of £600 a year. Alderman H. Murphy, J.P., seconded. After discussion, the amendment was passed, but it was decided to reduce the pension to £483 a year, the amount being based on a proportion of Mr. Bloxam's present salary and bonus, 23/60ths of £1,240. It is stated in the Belfast Press that Mr. Bloxam has tendered his resignation.

MR. J. S. SMITH of the engineering staff of the Sterling Telephone & Electric Co., Ltd., London, W.1, has been appointed manager of the South Wales branch (8, Park Place, Cardiff.)

A correspondent is anxious to get into touch with Mr. J. H. McKail, municipal electrical engineer, Singapore, and the Editors will be very pleased if the latter will communicate with them.

With reference to the proposed acquisition of the Bootle electricity undertaking, by Liverpool—the transfer has already been approved by the two councils concerned—the agreement between the Corporations provides that the Liverpool Corporation pays the Bootle electrical engineer, Mr. T. D. Clothier, £8,000 compensation, and retains the other members of the staff of the Bootle Electricity Committee.

The Leeds City Council, in response to criticisms, has appointed a special committee to review the salaries of the higher-paid officials of the Corporation. The total payment to the nine chief officials at present is £14,673 per annum, as against £8,250 in 1914. The salary of the electrical engineer, Mr. C. N. Hefford, is £1,500, as against the former £600, and that of Mr. J. B. Hamilton, tramways manager and general commercial manager to the Corporation is £1,584, as against a former £1,000. Two of the officials have received advances of more than 150 per cent. All the rest are smaller.

MR. JAMES F. WATTS, who has represented the Electrical Apparatus Co. for the last 9½ years, in the South of England, has now left that company to take up a similar position with Messrs. Robert Hornby & Co., 7, Carlisle Street, Soho.

To mark the occasion of his leaving the *Electrician*, the staff of that journal presented Mr. W. E. Warrilow with a silver-plated tray.

The marriage took place on January 2nd, at Chichester, of MR. J. S. CHILD (late joint sales manager to the Edison Swan Electric Co., Ltd.), to Miss E. L. Crunden.

MR. A. H. E. DAWE has severed his connection with Metropolitan-Vickers Electrical Co., Ltd., and has taken up a position as London sales representative for Messrs. Louis Dernier and Hamlyn, Ltd.

MR. A. W. RICHARDS, who has acted for many years as London representative for Messrs. Ward & Goldstone, Ltd., Manchester, has relinquished this position, and communications may be addressed c/o Stewart Engineering Co., 34, Mortimer Market, W.C.1.

MR. S. J. LEVI states that he is no longer connected with Messrs. Rose Bros. Electrical Co., Ltd., and has become managing director of Messrs. Spicer & Co., Ltd., 41, Red Lion Street, Clerkenwell E.C.1, dealers in electrical accessories and novelties.

Sixty-seven applications were received for the position of electrical engineer and tramways manager to the Heywood Corporation. There were five applicants selected to appear before the Committee, and Mr. H. C. Day, of Heywood, was appointed.

At a meeting of the Stafford Council last week the Electricity Committee recommended that the salary of the borough electrical engineer (Mr. W. H. Robins) be increased from £550 per annum to £650 per annum, in addition to the existing emoluments, in recognition of the enlargement of his duties brought about by the extensions of the electricity stations. The Salaries and Wages Committee, however, was unable to support the proposal, as it considered that the present time was inopportune. The recommendation was defeated.

Obituary.—HON. E. C. KITSON.—We regret to record the death of the Hon. Edward Christian Kitson (third son of the late Lord Airedale), chairman of Messrs. Kitson & Co., Ltd., locomotive engineers, of Leeds. He was 48 years of age.

DR. EDWARD HOPKINSON, M.P.—We deeply regret to record the death, which occurred on Sunday, at his residence at Alderley Edge, from pneumonia, in his 63rd year, of Dr. Edward Hopkinson, the distinguished electrical engineer, who had been from 1884 connected with Messrs. Mather & Platt, Ltd., of which company he was latterly a vice-chairman. He was also a director of the Chloride Electrical Storage Co., Ltd. We shall refer to the deceased gentleman's career further in our next issue.

MR. H. L. TAYLOR.—Mr. Harry Lee Taylor, managing director of Messrs. E. Taylor & Co., electrical engineers, Littleborough, passed away last week at the early age of 33 years. He had been in failing health for some months.

Wills.—The late Lieut.-Col. P. G. VON DONOP, R.E., left £4,522.

The late Lieut.-Col. PERCY J. PREECE, a son of the late Sir William Preece, left £3,219.

The late MR. H. WILSON-FOX left £63,020 gross, and £41,678 net personalty.

NEW COMPANIES REGISTERED.

Vio-Ray Electric Co., Ltd. (178,937).—Private company. Registered January 9th. Capital, £1,000 in £1 shares. To carry on the business of manufacturers of and dealers in all kinds of electrical and other goods, appliances, novelties, &c. The subscribers (each with one share) are: J. H. O. Emery, 50, Brightside Road, Hither Green, S.E.13, articled clerk; A. A. Henley, "Oak House," The Mount, Sydenham Hill Road, S.E.23, incorporated accountant. The first directors are not named. Solicitor: Kenneth C. Bartlett, 9-10, Fenchurch Street, E.C.

Berry, Wiggins & Co., Ltd. (178,880).—Private company. Registered January 6th. Capital, £1,500 in £1 shares. To carry on the business of manufacturing chemists, manufacturers, exporters and importers of and dealers in bitumen, asphaltums, waxes, resins, pitches, and tars, electrical compounds, marine glue, greases, and paints, &c. The permanent directors are: C. R. Berry, 3, Short Road, Stratford Market, E.15; A. E. Wiggins, 63, Milton Street, E.C.2. Registered office: 3, Short Road, Stratford Market, E.15.

Joseph Walton & Son (Nelson), Ltd.—(178,889).—Private company. Registered January 6th. Capital, £15,000 in £1 shares (5,000 15 per cent. cumulative preference). To acquire the business of an electrical and mechanical engineer and ironfounder carried on by Irvin Walton as "Joseph Walton & Son," at Walverden Foundry, Nelson. The subscribers (each with one share) are: Irvin Walton, 8, Belmont Road, Ansdell, engineer; T. Rowley, 44, Robert Street, Nelson, clerk. Irvin Walton is sole and permanent managing director, subject to holding the necessary qualifications, with £7 per week as remuneration. Qualification of directors: 250 shares. Registered office: Walverden Foundry, Nelson.

Multi-Way Earthing Clip, Ltd. (179,011).—Private company. Registered January 12th. Capital, £5,000 in £1 shares. To acquire the business carried on by A. E. Ryeland and C. A. Greenslade for the testing and developing of an invention for improvements in or relating to means for binding metallic tubing in electrical wiring installations, &c. The first directors are: A. E. Ryeland, 6, Mount Pleasant, Chatham Hill, Chatham; C. A. Greenslade, 15, Elmwood Avenue, Croydon, S.W.; H. Hibbard, Westcourt, Gillingham. Registered office: 44, Weston Street, London Bridge, S.E.1.

Shenton & Co., Ltd. (178,993).—Private company. Registered January 11th. Capital, £4,000 in £1 shares (1,000 preferred and 3,000 ordinary). To carry on the business of electrical, telephone, telegraph, mechanical, gas, motor, and general engineers, &c. The permanent directors are: A. Handley, "Rexton," Lichfield Road, Wylde Green, Birmingham (chairman); and C. J. Margerison, "Weston," St. James' Avenue, Sutton, Surrey, electrical engineer. Qualification of permanent directors: £1,000. Registered office: 68 and 69, Shoe Lane, E.C.

Culkin & Parkinson, Ltd. (178,921).—Private company. Registered January 9th. Capital, £2,000 in £1 shares (1,000 preferred and 1,000 ordinary). To carry on the business of electricians, engineers, manufacturers and workers of and dealers in electricity, motive power, and light, &c. The first directors are: J. Culkin, 52, St. James' Street, Leeds; J. Parkinson, 25, Gledhow Avenue, Roundhay, Leeds. Qualification, £10. Remuneration, £50 each per annum. Secretary: J. Parkinson. Registered office: 111, Woodhouse Lane, Leeds.

Electrical Insulating Composition Co., Ltd. (178,923).—Private company. Registered January 9th. Capital, £1,500 in £1 shares. To carry on the business of electrical engineers, drysalters, manufacturers of and dealers in electrical insulation composition, candles, tapers, boot and furniture polish, firewood, insulation tape, armature winding, and drysaltery products, and to adopt an agreement with A. Rigby and H. D. Shawcross. The first directors are: A. Rigby (managing director), 4, Grosvenor Road, Urmston, Manchester; H. D. Shawcross, "Acresfield," Cornhill Road, Davyhulme, Urmston (both permanent, subject to holding 400 ordinary shares). Qualification of other directors, £200. Remuneration of managing director, £50 per annum; other directors, £15 each per annum. Secretary: H. D. Shawcross. Registered office: Proval Works, Davyhulme Road, Davyhulme.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Western Electric Distributing Corporation, Ltd. (79,057).—Return dated September 3rd, 1921 (filed December 12th). Capital at the date of return, £45,000 in £1 shares (15,000 cum. pref., 3,000 pref. ord., and 20,000 ord.). 12,750 cum. pref., 2,875 pref. ord., and 24,328 ord. shares taken up. £39,428 paid, leaving £565 in arrears. Mortgages and charges: Nil. Capital increased to £50,000 by the creation of a further 2,000 cum. pref. and 5,000 ord. shares of £1 each.

Musselburgh and District Electric Light and Traction Co., Ltd.—Satisfaction to the extent of £1,300 on December 20th, 1921, of charges dated November 13th, 1905, and May 11th, 1909, securing £90,000.

Evans (Electrical), Ltd.—Debenture, dated December 14th, 1921, to secure £1,100, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: A. E. Pater, 1, Arcade House, Hendon, N.W.

Bourne End and District Electricity Corporation, Ltd.—Issue on January 11th, 1922, of £820, debentures, part of a series already registered.

CITY NOTES.

Prospectus.—*Fife Tramway, Light & Power Co., Ltd.*—An issue of £250,000 seven per cent. debenture stock at 93 has been offered. The list was announced to close on or before Friday; it actually closed on Tuesday morning. The proceeds of the issue will be applied in meeting capital expenditure incurred for the development of the properties during the past two years, including large additions to turbine and boiler plant, mains, and other extensions. Part of this expenditure has, in the meantime, been met by advances from the company's bankers, and these advances are to be repaid out of the proceeds of this issue.

Chatham and District Light Railways Co.—The revenue during 1921 was £87,270, and the expenses were £67,946, leaving £19,324, less £3,744 for rent of Rochester Corporation lines, £2,470 interest account, and £4,000 put to depreciation. Adding £1,609 brought forward, the balance is £10,719. After paying the 5 per cent. preference dividend, and 4 per cent. on the ordinary shares for the year, £599 is carried forward. There were decreases of £3,446 in revenue (due to coal stoppage and trade depression) and of £1,228 in expenses, as compared with 1920.

Fuller's United Electric Works, Ltd.—In the Chancery Division on Tuesday, Mr. Justice Russell gave his sanction to a petition asking for the confirmation of a resolution passed for the reduction of the capital of this company from £500,000 to £378,794 by cancelling capital loss or unrepresented by available assets.

Mexico Electric Tramways Co.—A general meeting of the holders of the 5 per cent. First Charge Debentures is to be held on February 8th to consider resolutions sanctioning proposed modifications of the rights of the debenture holders and of the provisions of the trust deeds embodied in a draft supplemental trust deed.

Styrian Electricity Co.—It is reported from Vienna that out of the three issues of capital offered by the Styrian Water Power and Electricity Co., to which we referred in our last issue, the ordinary shares in particular have been over subscribed. Foreign subscriptions were also received for ordinary and preference shares to a considerable extent.

London Underground Railways. — At extra-ordinary general meetings of the Metropolitan District, London Electric, City and South London and Central London Railway Companies, and the London General Omnibus Co., held last week at Westminster, the alterations in the Common Fund Agreement affecting these companies were approved.

Montreal Tramways Co.—A dividend of 2½ per cent. on account of accumulations is announced, leaving arrears of 2½ per cent.

Adelaide Electric Supply Co., Ltd.—A Reuter dispatch from Melbourne states that this company, which in March last transferred its head office from London to the South Australian capital, is making a fresh issue of debenture stock at 7½ per cent., totalling £350,000. The term of the issue is 12 years.

Electrical Utilities Co.—A quarterly dividend of 1¼ per cent. on the preferred stock is announced.

STOCKS AND SHARES.

TUESDAY EVENING.

No abatement in the demand for investment stocks and shares is noticeable. The money market has an occasional tremor of strength which is used as a reason for pointing out that investment securities are standing quite high enough. As soon as the real character of the position becomes again disclosed, the quotations rally, and with the War Loan standing close to its issue price (in January, 1917) of 95, all other investment stocks are encouraged in their upward march. The supply of existing stocks and shares becomes more and more limited. In spite of the enormous outpouring of new issues, the power of absorption shown by the investor displays little or no diminution. The gains shown this week in our price-lists outnumber the falls by eleven to one.

Home electricity shares continue to be one of the firmest markets on the list of ordinary shares quoted in our tables. The investor has obviously been struck by the high yields offered by the leading companies, with the result that there is an eager demand for the majority, with little or no stock to meet it. Chelsea, County of London, and Westminsters show advances, but the London shares may be described as all better, even where the nominal quotations remain unchanged. Inquiry is now spreading to the provincial companies' shares, and Oxfords, for instance, have moved up to £3.

The reduction in the price of electricity, announced by the Westminster company, is held as an indication that the other companies will shortly follow suit, and that the promised era of cheap electricity for application to every-day purposes may come about, after all, as the war conditions give place to a more normal state of affairs. Hints of possible trouble in the coal trade are disregarded. Some of the companies have recently been approached by their financial advisers pointing out that, with the public appetite so eager for new securities, the present time may offer a good opportunity for obtaining fresh capital. The obvious answer is that unless the companies actually want cash, they stand to do better by waiting for a time, for the indications point to money becoming cheaper, which would, of course, have the effect of enabling new money to be borrowed upon terms more advantageous than those prevailing to-day. However, it is taken for granted that, before long, several of the electric companies will be in the field. The example of the County of London 7 per cent. debenture stock now standing at a premium of about 10 points above its issue price of 94 affords a good illustration of the investor's appreciation of the security which such issues offer.

At the meeting of the Underground Electric Railways, held at the end of last week, Lord Ashfield, the chairman, amplified the reasons why it is reasonable to re-adjust the proportions of the pooled money divided amongst the five members of the group. Several questions were put to him with regard to fares, but these he discreetly turned aside as being irrelevant, though he admitted that the subject was under consideration. The resolutions in respect of the new sharing agreements were duly carried, and the market for the stocks remains firm, though the outstanding feature continues to be the way in which the prior-charge stocks are sought after by the investor. Central London ordinary, Metropolitan and Districts stand higher on the week.

The frequent references made here to the attractions of cable stocks have received a good deal of emphasis during the fortnight by reason of the rises that have occurred in various issues. The Eastern group is particularly good, with Westerns and Globe ordinary up to 17, and with buyers about at this price. Eastern ordinary is firm at 168¼. With these stocks, Telegraph Constructions are also rising, the price being 10s. up at 22½. Direct United States have hardened to 6. The sharp rises in Anglo-American stocks, due to bonus declared with the dividend on the ordinary and deferred descriptions, have been caried further, and the whole group shows a strength which would amount to buoyancy were it not for the fact that the limited amount of stock available for investment causes the market to be, as the House says, "all one way," the way at the present being for buyers greatly to predominate. Marconis are somewhat dull. The parent shares eased off to 33s. 9d., and Marconi Marines to 21s. 9d.

The issue of £250,000 Fife Electric Tramway debentures at 93, mentioned here last week as on the way, was over-subscribed in about a couple of hours. Indeed, it is said that the applications for the stock came to over a million pounds in less than half that time.

Llanelly 7½ per cent. debenture has been up to 2½ premium, but slipped back again to 2 premium. Reading Electric debenture is firm at 4¾ premium, Midland Counties 7½ per cent. remains at 99, which is 3 premium, and a feature of the week is the way in which British Thomson-Houston debenture has jumped a couple of points to 4½ premium. In the notes published here last Friday it was said that the stock, then standing at 2½ premium, "looks as though it will be improved still further." The present price may tempt profit-taking. General Electric debenture has advanced to 100. A rise of 5s. makes Clyde Valley Electric second preference ½ premium. These £10 shares will become fully paid at the end of the month, and are worth more money, having regard to their security and to the yield, £7 12s. 5d. per cent., on the investment. Many of the Mexican utilities are higher on the week. Vague optimism is again expressed with regard to the possibility of Washington recognising Mexico. Mexican Electric Light first mortgage bonds have risen to 35½, Mexican Light & Power seconds to 56½, Pachuca fives to the same figure. Mexico Tramway firsts and seconds are both better. At the same time, improvements have occurred in Rio Tramways firsts to 94¼ and in San Paulo fives to 90. Brazilian Tractions gained 1½ at 33, and the preferred at 76¼ are also higher. In the Argentine group, Anglo-Argentine Tramways firsts and seconds are both 1/16 to the good, the 5 per cent. debenture stock at 66½ being a point higher. Fresh advances occurred in British Columbia Electric issues, on the expectations, referred to last week, of a good report and the probability of dividends being maintained at the rates declared a year ago, which were 5½s. in the case of the deferred and 2½s. in that of the preferred stock.

London United Tramways preference strengthened to 3s., but Underground Electric issues remain without change, the "A" shares being 6s. The engineering group is firm, with Babcock & Wilcox better at 50s. Armaments are weak, with Vickers offered at 8s. The rubber market shows no changes worth mentioning, the list being depressed by the low price of the raw material, in spite of the weekly statistics of landings and deliveries being more favourable to the industry.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend. 1919.	Dividend. 1920.	Price Jan. 17, 1922.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	12	12	6⅝	—	£9 1 2
Charing Cross Ordinary	7	8	4⅝	—	8 13 8
do. do. do. 4½ Pref.	4½	4½	8¼	—	7 4 4
Chelsea	4	6	8⅛	+ ⅛	8 5 6
City of London	13	14	1 7/16	—	9 14 10
do. do. 6 per cent. Pref.	6	6	19/-	+6d.	6 6 4
County of London	8	8	9½	+ ⅛	8 15 4
do. do. 5 per cent. Pref.	6	6	8⅛	—	7 7 8
Kensington Ordinary	7	9	6¼	+ ⅛	8 11 6
London Electric	2½	2½	1	—	7 10 0
do. do. 6 per cent. Pref.	6	6	8⅛	—	9 12 0
Metropolitan	6	7	4	—	8 15 0
do. 4½ per cent. Pref.	4½	4½	21½xd	+1/9	7 13 2
St. James' and Pall Mall	12	12	6¾		8 14 6
South London	6	7	2¾	—	10 9 0
South Metropolitan Pref.	7	7	17/6	—	8 0 0
Westminster Ordinary	10	10	6¼	+ ⅛	8 3 4
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	£9xd	+2	6 14 10
do. Def.	1½	1½	19xd	+1½	9 8 6
Chile Telephone	6	6	5½xd	—	5 17 1
Cuba Sub. Ord.	7	7	7	—	10 0 0
Eastern Extension	10	10	16⅜	—	5 19 5
Eastern Tel. Ord.	10	10	168¼	—	5 18 8
Globe Tel. and T. Ord.	10	10	17	+ ½	5 17 8
do. do. Pref.	6	6	9⅝	+ ⅛	6 1 6
Great Northern Tel.	22	24	26½	—	9 1 2
Indo-European	10	10	30½	—	8 5 4
Marconi	25	15	1 1/16	— 1/16	8 17 10
Oriental Telephone Ord.	12	12	2	—	*6 0 0
United R. Plate Tel.	8	8	6	+ 1/16	*6 13 4
West India and Panama	Nil	Nil	5/-	—	Nil
Western Telegraph	10	10	17	+ ½	*5 17 8
HOME RAILS.					
Central London Ord. Assented	4	4	54½	+2	7 6 10
Metropolitan	1½	1½	28½	+ 1½	5 5 8
do. District	Nil	Nil	23	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	2½	—	Nil
do. do. "A"	Nil	Nil	6/-	—	Nil
do. do. Income	4	2	76½	—	*2 18 6
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams, First Pref.	5½	12½	2 1/16	+ 1/16	10 4 8
do. do. 2nd Pref.	Nil	5½	2 1/16	+ 1/16	9 11 4
do. do. 5 per cent. Deb.	5	5	66½	+1	7 10 6
Brazil Tractions	Nil	Nil	33	+ ½	Nil
British Columbia Elec. Ry. Pfce.	5	5	61½xd	+1½	8 2 8
do. do. Preferred	5	2/6	58½	+1	*7 18 0
do. do. Deferred	3	12/-	61½	+1½	*10 2 10
do. do. Deb.	4½	4½	63¼	+1	6 16 0
Mexico Trams. 5 per cent. Bonds	Nil	Nil	56½	+2	—
do. do. 6 per cent. Bonds	Nil	Nil	16½	+1	Nil
Mexican Light Common	Nil	Nil	12	—1	Nil
do. Pref.	Nil	Nil	28½	+1½	Nil
do. 1st Bonds	Nil	5	61½	+2	8 8 0
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	16	2½	+ ½	6 8 9
British Aluminium Ord.	10	10	16/9	+9d.	—
British Insulated Ord.	15	15	1 1/16	+ 1/16	9 12 0
Callenders	15	15	1 1/16	+6d.	10 8 8
" 6½ Pref.	6½	6½	18/9xd	—	6 18 8
Crompton Ord.	10	10	13/9	—	14 11 0
Edison-Swan	10	—	6/3	— 3d.	—
do. do. 5 per cent. Deb.	5	5	62	—	8 1 4
Electric Construction	10	10	18/3	—	10 19 2
English Electric	8	8	10/-	—	16 0 0
do. Pref.	6	6	13/9	—	8 14 6
Gen. Elec. Pref.	6½	6½	18/3	+6d.	7 2 5
do. Ord.	10	10	19/6	+9d.	10 5 4
Henley	15	15	1 5/16	+9d.	9 12 0
do. 4½ Pref.	4½	4½	8¾	—	6 4 2
India-Rubber	10	—	1/9	—	—
Mot.-Vickers Pref.	8	8	1½	—	9 2 10
Siemens Ord.	10	10	22/-	—	*9 1 10
Telegraph Con.	20	20	22½	+ ½	*5 5 9

* Dividends paid free of Income Tax.

THE PHYSICAL SOCIETY OF LONDON.

TWELFTH ANNUAL EXHIBITION.

(*Continued from p. 48.*)

The COX-CAVENDISH ELECTRICAL CO., LTD., exhibited a gold-leaf electroscope, fig. 8 (designed by Dr. E. A. Owen, M.A., of the National Physical Laboratory) in which the gold leaf A is attached to a rod B screwed into an insulator D of ebonite ringed with sulphur. The charing rod F is capped with ebonite, and is held up in its top position by a spiral spring, a loose flange E on its lower end, which is maintained in its position by a weak spring, makes contact when the rod is depressed with a flange C on the rod holding the gold leaf. Thus the instrument cannot be injured by pressing down the charging rod too hard. The chief point to look to in an electroscope is the insulation of the leaf system. Ebonite is a poor insulator, and it deteriorates rapidly with exposure

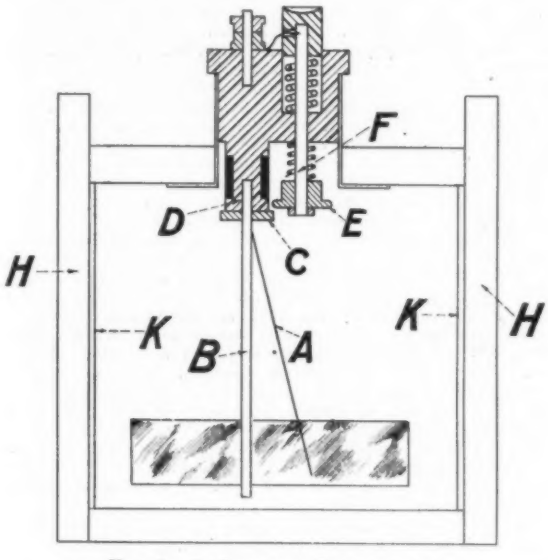


FIG. 8.—A GOLD-LEAF ELECTROSCOPE.

to a damp atmosphere. The best material to employ as insulator would be sulphur or amber, but the former is ruled out in this case on account of its weakness mechanically, whilst the latter is at present difficult to obtain, and suffers from the same defect as sulphur, though not to the same degree, in that it is not mechanically strong. The insulating properties of ebonite can be greatly improved by the old method of letting sulphur rings into it, as used in the present case and found to be satisfactory; the cylinder is immediately mounted as described, kept in the dark, and guarded against the deposition of dust. The gold leaf is about 4.5 cm. long; the end of the leaf falls through about 0.11 millimetre in one hour

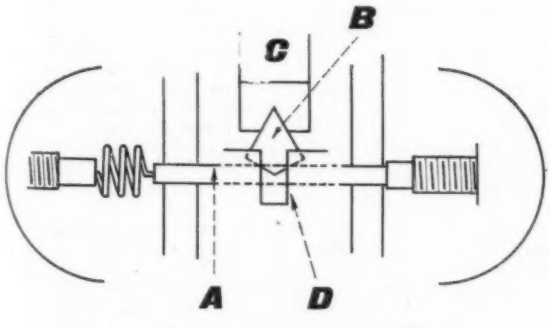


FIG. 9.—AN ELECTROSTATIC OSCILLOGRAPH.

when the potential is kept at 280 volts, while a change of potential of 1 volt on the leaf moves it through about 0.51 millimetre. The amount of soakage in the ebonite insulation is small, and reliable readings may be taken with the instrument in about five or ten minutes after the leaf is initially charged. The sensitivity of the instrument is constant over the whole scale of the microscope, so that readings may be taken indiscriminately over any part of the scale. For y-ray measurements the whole of the electroscope is covered with lead about 25 in. thick; for X-ray measurements the two end faces H are removed, and the rays pass into and out of the instrument through aluminium windows K of suitable thickness.

Prof. Taylor Jones's electrostatic oscillograph, figs. 9 and 10, for use with potentials of from 5,000 to 250,000 volts consists of a strip of phosphor bronze A or steel 1.75 cm. long stretched between substantial ebonite jaws, the tension being adjustable by means of a nut and sliding screw. A mirror B of elongated form is attached at one end to the centre of the strip, while the other end rests on an adjustable ebonite pillar C, which forms a fulcrum, so that the mirror rocks through a small angle in response to any movement of the strip. The movement is immersed in oil, the liquid serving for both insulating and damping purposes. Opposite to the centre of the strip when in position in the container is the attracting plate E embedded in an ebonite rod F, which passes through the container wall, while on the side of the strip remote from this is a small plate of metal D in electrical connection with the strip, and therefore repelling it. A window G in the container allows a beam of reflected light to be used for recording. For different ranges of potential different containers fitted with attracting plates at different distances, and shielded by different thicknesses of ebonite are used, the movement being the same in each case. The reflections are,

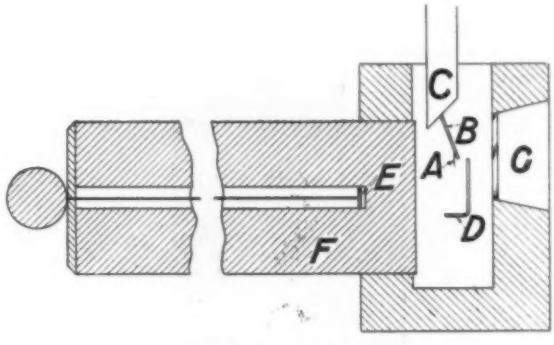


FIG. 10.—AN ELECTROSTATIC OSCILLOGRAPH.

of course, proportional to the square of the potential. The instrument as described can be used for frequencies up to 1,500, but above that figure a special form having a strip only 3 mm. long is used.

MESSRS. EVERSHED & VIGNOLES, LTD.—The Needham electric revolution counter, fig. 18, manufactured by the firm, is designed for the purpose of counting revolutions, or other operations, at any distance from the machinery. For revolutions up to 400 per minute it is made to count single revolutions; but if required to count at a higher speed than this the transmitter is suitably geared down from the revolving machinery, so as to count one in every ten revolutions—a nought being added at the unit end of the counter dial. The counter has the appearance of an ordinary mechanical counter, but its working parts are designed upon an entirely

FIG. 18.—THE NEEDHAM REVOLUTION COUNTER.

new principle. It is combined with a step-by-step electric motor driven by energy derived from ordinary electric light mains. In order to secure that the counter shall operate with certainty it is necessary that the motor, while being sufficiently strong to rotate all the counter dials simultaneously when required, shall not move with such violence as to risk damaging the first dial when the latter only is rotated. The ordinary mechanically-locked counter is therefore unsuitable, since it is liable to stick when all its dials

are moved simultaneously, and therefore requires considerable power in reserve. The new counter consists of a number of dials, each arranged to be locked mechanically in any of ten positions corresponding to the digits 0 to 9, but mechanically entirely independent except during the time when a change of indication is in progress. The effect of this magnetic lock is to enable each unit to be made very free from friction; and it has the additional advantage that it helps to reduce the power necessary to change the indication of all digits simultaneously. The step-by-step motor is also novel. While providing ample power for moving the counter, its elements are light enough to work with certainty up to speeds exceeding 400 per minute. The motor is of the rotary type, no reciprocating motion being employed; it operates with two wires only instead of the usual three, thus reducing the cost of installation to a minimum. It will work satisfactorily on 70 per cent. of its normal pressure, a feature which enables it to be used in ordinary electric light circuits; and its internal resistance is such that no variation of contact resistance in the transmitter will affect its proper working. The transmitter is a plain make-and-break mechanism, and is made in various forms to suit different requirements.

The new recording instruments recently produced by the firm incorporate all the valuable features of the previous instruments embodying the Murday system, together with improvements. The outstanding feature of the Murday system is a chart having rectangular co-ordinates. The pen records on the top of the chart and the whole record can be clearly read, and is visible for several hours. The simple and strong construction of the pen enables it to be handled by comparatively unskilled operators with impunity. In the new design—fig. 19—the clock is placed underneath the chart, thus making the instrument more compact than heretofore. The usual pattern of instrument is fitted with a continuous roll chart, which has a length of 65 ft.—that is, at 1 in. per hour it will last for one month. The insertion and removal of this chart is extremely simple, and arrangements are made

Fig. 19.—A Recording Instrument (Murday's Patent).

so that the chart can be easily set to time simply by turning a milled head on the driving spindle. The chart speeds can be changed without the use of tools; additional change wheels are provided, which are secured under milled heads at the side of the clock. The clock in itself is powerful, and more of the character of a clockwork motor than of a clock in the watch-makers' sense. The whole of the clock, with the exception of the main spring and escapement, is manufactured by the company.

The chart is perforated at both edges and driven by pegged wheels, thus eliminating any position errors in timekeeping due to the effect of atmospheric changes on the paper. The chart passes over a firm surface, permitting notes to be written on the paper while going through the instrument. The lower spool on which the record is stored is driven by a spring belt from the main driving spindle, and a range of speed from ¼ in. per hour to 12 in. per hour can be provided by simply changing external wheels, as mentioned above. For high speeds a change-over lever is provided to throw in a fly governor instead of the escapement. A new feature introduced into these instruments is the fitting of a reservoir trough for the ink, which permits a continuous record to be obtained on fluctuating loads for the whole period of the chart without attention. Drum- and disk-type instruments are constructed on the Murday system, and all types are made in switchboard and portable paterns. The electrical movements are extremely robust, and embody the latest improvements, both as regards spring-seated jewels, preventing damage to the pivots, and the damping of the movement to prevent fluctuations due to the inertia of the movement itself.

In addition to the ordinary pattern of instrument a duplex, or log, type of recording instrument has been produced, to enable either an ammeter and voltmeter record to be obtained on one chart, or two ammeter, or two voltmeter, as required. If necessary, of course, a wattmeter record can also be given.

Marconi's Wireless Telegraph Co., Ltd., demonstrated the action of the "four-second alarm" automatic apparatus, which responds to a call from a vessel in distress in the event of the operator leaving the receiver temporarily unattended. The device, which was referred to on p. 892 of our issue of December 30th, 1921, is not affected by general wireless working or atmospherical discharges; it will save money by doing away with the necessity for providing several operators, and will not respond to messages of a similar character to the "S.O.S." because the distress signal proper is preceded by an alarm signal which, as the name of the device indicates, consists of a prolonged dash of four seconds, followed by a space of one second, the alteration of the dash and space being continued for one minute.

Messrs. Creed & Co., Ltd., demonstrated high-speed automatic printing telegraphy. The keyboard perforator used is similar in appearance to a typewriter; the depression of a key sets up a combination of punches, so that the corresponding Morse symbol is perforated in the paper strip. The long narrow paper ribbon, "punched up" with the complete message, is next passed through a Wheatstone transmitter, in which the lever is automatically controlled by selecting needles, which pass through the holes in the paper strip as the latter moves over the platform, and causes the key to send out the successive electrical impulses. The incoming signals at the receiving station are caused to actuate, by means of an electromagnet, an escapement lever which, at the proper moment, releases or arrests, as the case may be, the rotation of a pair of cams that controls the punches which (as they are forced through the paper, with every reversal of the current, which takes the form of the Morse code) punches the strip of paper with a corresponding series of holes, and reproduces an exact replica of the original slip prepared by the keyboard perforator. On leaving the receiver the punched slip passes to a printer, that transposes the Morse code perforations into Roman characters. This is done by allowing selecting needles to pass through the holes in the slip, which action sets up a combination in a number of comb disks that, in turn, actuates a mechanism that arrests the rotating type head and brings a selected letter opposite the printing point. The speed of the Creed apparatus ranges from 50 to over 200 words per minute. On the firm's stand a 300-kW wireless telegraph transmission key was also seen.

The Hewittic Electric Co., Ltd., photographic enlarging outfit is fitted with mercury-vapour tubes, which give an actinic and well-diffused light. No condenser is required, and the current consumption is low. The set used for portrait work derives its light from one Cooper-Hewitt lamp, and equipments are also manufactured with a number of tubes for use in kinematograph studios. The silica spectroscopic burner is designed specially for use with spectroscopes, and is fitted with an end window. Laboratory outfits are supplied for experimental work in connection with ultra-violet light. They are also extensively used for testing the fastness of colours and for promoting certain chemical reactions. The burner is made of quartz, which has the property of fully transmitting the ultra-violet rays which are found in abundance in the mercury arc, but which are entirely absorbed by the lead glass used in Cooper-Hewitt lamps that are supplied for illuminating purposes. These outfits are admirably suitable for pathological, physiological, and industrial chemical work. The Berlemont burner is a silica burner suitable for operating on either a.c. or d.c. circuits, and attains its maximum efficiency almost immediately it is started up. It is static starting, and is designed with a view to overcoming transport difficulties, so that it can be quite roughly handled without any detrimental effects. Medical lamp outfits are supplied for treatment of various skin diseases, wounds, &c., by means of ultra-violet light. Many physicians claim that they have obtained beneficial results in connection with gout, surgical tuberculosis, pulmonary tuberculosis, &c., by their use.

Mr. F. Harrison Glew demonstrated radio-activity by means of various scintilloscopes, and exhibited radium, ionium, actinium, mesothorium, polonium, cloud-condensation apparatus, range of alpha particles (both the latter by compression), and self-luminous radium compound—strip and sheet—for cutting to any shape.

The Glew improved flat applicators, as adopted by the Medical Research Council, are said to be permanent, and may be made of any shape, flat or curved, and of great activity—up to 40 mgms. per sq. cm. if required. The Strutt radium clocks show the continuous production of electricity, the most useful demonstration of radio-activity, and are suitable for lecture projection or museum purposes, &c. Radium spirals for collecting atmospheric electricity, as used at Greenwich observatory, and radium standards, both solid and in solution, were also shown.

(*To be continued.*)

THE IMPORTATION OF FOREIGN ELECTRIC LAMP BULBS.

FOR some weeks now a committee appointed by the Board of Trade under Part II of the Safeguarding of Industries Act, has been inquiring into a complaint by the British Flint Glass Manufacturers' Association and the National Flint Glass Makers' Society, that articles of domestic glassware, illuminating glassware, and mounting glassware manufactured in Germany and Czecho-Slovakia are being sold, or offered for sale, in the United Kingdom at prices which, by reason of the depreciation in the value, in relation to the sterling, of the currency of the above-named countries, are below the prices at which similar goods can be profitably manufactured in this country. The first meeting of the Committee took place on December 12th, 1921, and a great deal of evidence has been heard respecting the various classes of glassware enumerated. It was not, however, until Wednesday, January 11th, that the question of glassware used in the electrical industry was dealt with, and then electric lamp bulbs were discussed. The Committee, under Part II of the Act, can recommend that a tax of 33⅓ per cent. should be imposed, and it then remains for the Board of Trade to act.

Mr. CHRISTOPHER WILSON said that he was a director of the General Electric Co., Ltd., and managing director of the Osram-G.E.C. Lamp Works, Hammersmith, of the Lemington-on-Tyne Glass Works, and of the Tyne Glass Works, Gateshead-on-Tyne, all of which were owned by the General Electric Co., Ltd. When working full time, the company's bulb requirements amounted to approximately 30 millions per annum. Their requirements in pre-war times had been satisfied partly by the output of their own works at Lemington-on-Tyne, and partly by the purchase of foreign bulbs. Considerable quantities of bulbs were made in this country before the war, but during the war, when foreign imports were no longer possible, other English glass manufacturers took up the manufacture of bulbs, and very large quantities were made, the output rising in the aggregate to about one million per week, the General Electric Co. reaching over 600,000 per week. As was natural, at first the quality of the English bulbs was poor, but as the makers became more used to their new work the quality had been steadily improving, and the Lemington works now produced a bulb which compared well with any bulb in the world. The G.E.C. had invested over £300,000 in the glass business, and it had always been their policy to maintain the English industry in bulb making, in order to avoid complete dependence on foreign supplies, and, in the interests of the country, Mr. Wilson considered it was of vital importance that this policy should be encouraged. It had always been possible to purchase foreign bulbs more cheaply than English bulbs. Before the war the relative prices of similar bulbs were:—English bulbs, 53s. per 1,000; foreign bulbs delivered London, 44s. per 1,000, less breakage allowance and export rebate, making 36s. 6d. per 1,000. Since the war this discrepancy in price had increased. The present price per thousand of German bulb No. 0362 was:—

At works.		Freight.	Delivered.
46s. 6d.	plus	9s. 10d.	56s. 4d.

as against British total cost of manufacture of approximately 135s., of which 63s. 11d., or 48 per cent., was represented by labour, and the balance by fuel, materials, and overhead charges.

Similar figures for bulb No. 564 were:—

At works.		Freight.	Delivered.
50s. 3d.	plus	9s. 10d.	60s. 1d.

as against the British cost of approximately 140s., of which 65s. 7d., or 48 per cent., was represented by labour.

With regard to the suggestion made by certain witnesses that no bulbs had been imported from Germany or Czecho-Slovakia since the war, Mr. Wilson said this was absolutely untrue. He had been inundated with quotations of all kinds, and he could only say that he had himself purchased from Germany and Holland since June, 1921, upwards of two million bulbs. At the present time the electric lamp trade was undoubtedly quiet, but it was a matter of recent and temporary occurrence, and he could say, without hesitation, that the original and fundamental cause of unemployment in the bulb trade had been the very low price at which, owing to the depreciation of the mark, it had been possible for the Germans to put their bulbs on to the English market. So far as bulbs were concerned, Belgium could not compete with Germany. The quotations which Mr. Wilson had obtained for Belgian bulbs showed that they were considerably more expensive. In his opinion, if relief were given under the terms of the Safeguarding of Industries Act, it would certainly tend to increase employment among English bulb blowers, and the benefit of the duty would be increasingly felt as foreign currencies recovered.

Replying to questions by the Committee—

Mr. WILSON said that considerable quantities of bulbs were made in this country before the war outside his firm. His own firm made about 65 or 70 per cent. of its own requirements in the ordinary way and imported the remainder, but at present, owing to the decreased demand, his own glass works were able to make all the bulbs which the Hammersmith lamp works required. He had no exact figures of the total production in this country. At the beginning of the war his glass works were making 250,000 bulbs per week, and in the busiest time they made 650,000 per week. The prices mentioned for the English bulbs were the usual prices here, the bulbs in his case being charged up to the lamp works at the market price.

The CHAIRMAN (Sir William Ashley) drew special attention to the statement made by witness that since the war the discrepancy between the British and the foreign price had increased. According to the figures, the British price had increased 150 per cent., and that of the foreign bulb 50 per cent. Had witness any doubt as to affirming that?

Mr. WILSON said his figures proved that. The increase was due to greater cost of materials and labour. He held no brief for British labour as regards glass blowers. He had given orders abroad, and could speak of actual prices in respect of them.

The CHAIRMAN said he wished as much information to be given publicly as possible. Could witness say the size of the orders, and when they were given?

Mr. WILSON said he had placed an order in Germany for one million bulbs, and a similar order in Holland, during the last six months. One of the reasons for giving these orders was to bring home to the British workman the nature of the foreign competition we had to meet. Another reason was the coal strike; and a third reason was a desire to test the quality of the foreign lamps. At the present time his works were on half-time, *i.e.*, working alternate weeks, so that he was able to make all the lamps he required here. With regard to glass blowers' wages, the pre-war rate was 9¾d. an hour, but that was pushed up to 4s. an hour during the war. That was what was earned on piece-work. Therefore, he held no brief for the workman, but he must say that they were now in a very much better frame of mind than they were a little while ago, because they saw the danger of foreign competition. At the same time, he did not altogether blame the workman for the state of the industry here. The employers were also to blame. Many of the works were not as up-to-date as they should be, but that was due to the fact that these particular firms had not the money to install modern plant. His own firm had been better situated in that respect than most of the others. He did not say that a 33⅓ tax would be a very great help to the trade at the moment to compete in price with the German bulbs, and it would be of no assistance to them if they did not help themselves by putting in modern furnaces and so on. If the trade did that, then the tax would be a help, especially as it was naturally hoped that the exchange would improve. Then they would be able to compete.

Answering Sir THOMAS ALLEN (a member of the Committee) on the question of the labour employed now compared with pre-war, Mr. WILSON said he was employing more now in spite of the fact that they were working half-time. Before the war he had 240 employés, and now they were 517, working alternate weeks. Just after the armistice, the number employed was 720. Whilst the number employed was decidedly larger than in 1914, the works could employ more workpeople than they actually did.

In reply to Sir JOHN BARRAN: They had always lost money on their glassworks, but as they were making for their own consumption, they were not troubled so much as they would otherwise have been. The policy had been to make this country less dependent upon foreign supplies and to increase the output. They were feeling German competition before the war, but they had enormously increased their output as between 1914 and now. That was due to an increase of plant and an increase in the number of up-to-date furnaces. He had sent a man round the country to try and secure orders for bulbs, but he had come back with the report that everywhere he was met with German competition at prices which we could not touch.

Asked for a reason for the ability of the Germans to turn out bulbs cheaper than ourselves, Mr. Wilson said it was due in a large measure to the greater technical knowledge of the German industry. The German workpeople were better trained also. He had his manager in Germany at the present time studying the conditions there. The equipment of the factories was in most cases better than that of the average British works. Even so, if the exchange were normal he believed we could compete.

The attention of Mr. Wilson was called to the fact that in a letter from the German Embassy it was stated that the German Government had made a regulation that all quotations for goods for export were to be on the basis of the mark at 280 to the £.

Mr. WILSON said he had a quotation received a few days ago, but there was no reference to such a regulation. It would be a step in the right direction, however, to assist the British glass maker.

Asked as to the prices at which he placed orders in Germany and Holland for bulbs, Mr. Wilson said the German price was 53s. 8d. per thousand and the Dutch price was 115s. 1½d. per thousand for an inferior article. The Dutch could not compete with the Germans.

The Committee adjourned.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Kinematograph Film Display.

On Thursday evening last week an unusually large number of members assembled at the Institution to witness a display of three kinematograph films, which were much appreciated. Following the reading of explanatory notes, which are abstracted below, by Dr. C. C. Garrard, M.I.E.E. (General Electric Co., Ltd.), the accompanying illustrations were thrown on the screen and were followed by a film which showed the effects of large-current tests on various electrical apparatus.

Mechanical and electrical effects of large currents on h.p. switchgear.—The tests briefly described by Dr. Garrard were carried out by the New York Edison Co., and were recorded in a paper* by Mr. Philip Torchio, who at the suggestion of Dr. Garrard sent the films showing the experiments to this country to be exhibited for the benefit of British engineers.

The experiments with switches were made with currents of the order of 100,000 amperes at 25 cycles, but at low voltages (about 200 volts), the object of the tests not being to determine the breaking capacity of the switches, but to find out in what way the apparatus withstood the very large mechanical stresses set up by the immense currents used. In all the switch tests the circuit breakers were mechanically locked in the closed position. The arcing that was seen on the films was caused by the opening of the main and arcing contacts due to the mechanical force resulting from the flow of the high current. The justification for such a test lay in the fact that the short-circuit current in actual practice in a power station reached its maximum with very great rapidity, and before the operating mechanism had had time to open under short-circuit. During the period before the automatic opening of a breaker, therefore, it was (in effect) locked in, and its mechanism must withstand the mechanical forces set up by the current which might, moreover, be greater than that corresponding to the kVA breaking capacity of the oil-immersed breaker. If, for example, the breaker be chosen under the assumption that the short-circuit current fell off to six-tenths of its maximum value within one-fifth of a second, the mechanical forces set up before the oil circuit breaker operated would be those corresponding to a current 66 per cent. greater than that corresponding to the kVA rating of the breaker.

It must not be assumed from the film that the switches which apparently failed were in all cases inadequate to withstand a test equal to their rating. The numerical figures of the tests must be studied in order to arrive at a conclusion in this respect, as in some cases the testing currents were carried above those corresponding to the breaking capacity rating in order to compare different types of construction.

Practically all the circuit breakers tested had brush contacts arranged as shown in the first diagram, fig. 1, that is to say, that when the current flowed the resultant mechanical force acted in a direction opposed to the brush pressure, thus tending to open the contacts and cause them to burn and weld together. This could be understood by reference to the principle that a closed electric circuit always tended to open out and enclose the maximum area.

As the result of the experiments an improved arrangement of the brushes was introduced and was illustrated in fig. 2, from which it would be seen that the force set up by the current increased the brush pressure. The motion-picture clearly showed the improvement effected. Some of the best

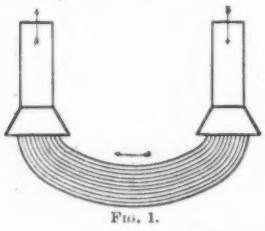


Fig. 1.

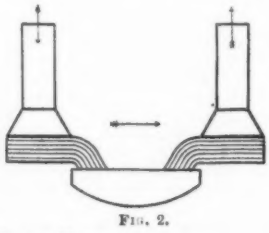


Fig. 2.

Fig. 1—Type of Brush Tested.
Tends to come out of contact under the influence of the current.

Fig. 2.—Improved Inverted Brushes.
Tends to press on tighter due to the magnetic forces set up by current.

results, however, were obtained with finger contacts as shown in fig. 3 (A) from which it would be seen that in such a contact the current flowed through each finger in the same direction. The fingers, therefore, attracted each other under the influence of the current and thus the contact pressure was increased; fig. 3 (B) was introduced by Dr. Garrard to illustrate a construction whereby this attracting force might be increased by bringing the fingers very near together.

The results of the tests on current transformers clearly showed the enormous forces which current transformers were subjected to on short-circuit. In one test (original fig. 18) the transformer was destroyed in ½ second at 92,000 amps. (r.m.s.). Mr. Torchio's conclusion was that only the single-turn primary type was suitable for large systems. Dr. Garrard pointed out, however, that it was not always possible to use that type in feeder circuits.

The tests on potential transformer fuses were carried out at the full voltage of 6,600 and 13,000 volts. The definite conclusion was arrived at that no type of potential fuse on the market can satisfactorily open the circuit without a resistance in circuit (see fig. 4). As an example it might be mentioned that a fibre-tube fuse having a resistance itself of 79 ohms failed completely at 6,600 volts, the current flowing through the fuse being 1,970 amperes (maximum). The addition of 50 ohms external resistance reduced the current to 25 amperes (maximum) and the fuse operated without visible disturbance in 0.02 cycle.

Regarding tests on disconnecting switches, the need of locking devices and the desirability of avoiding bends in the connections to the switches were demonstrated. When these cannot be avoided the blade opening should be at right angles to the main lead.

The original paper showed the valuable information which might be obtained by collaboration between manufacturers and

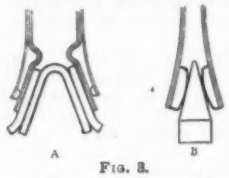


Fig. 3.

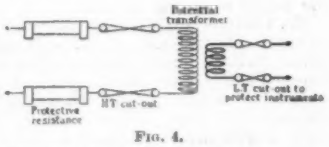


Fig. 4.

Fig. 3.—Finger Contacts of Oil Circuit Breaker.
The current flowing in the same direction in both fingers causes them to attract each other and thus increase the contact pressure.

Fig. 4.—Potential Transformer with Protective Resistance.
Suggested British standard arrangement for heavy systems.

supply authorities. Similar co-operation under the direction of the British Electrical & Allied Industries Research Association would doubtless yield like results in this country.

The Audion.—The second and third films were exhibited by Mr. F. Gill, M.I.E.E. (European chief engineer: Western Electric Co., Ltd.) and illustrated their respective subjects in a popular manner; they were self-explanatory. The second film showed the evolution of the thermionic valve and illustrated in a remarkably clear and ingenious manner the action of the valves when performing various functions.

Telephone Inventors of To-day.—The third film showed the gradual assembly of the numerous component parts that go to make the complete telephone desk instrument (apparently without hands). The remainder of the film illustrated early apparatus, modern switchboards, and the action of transmitters and receivers, in addition to mechanical tests, railway train control (dispatching), printing telegraphy, the operation of automatic coin collectors, telephone repeaters and loading coils, and the use of telephony in the army and air force.

CYC-ARC AUTOMATIC ELECTRIC WELDING.

Discussion at Bristol.

At the Western Centre of the Institution of Electrical Engineers, on December 5th, Messrs. L. J. Steele's and H. Martin's paper on the above subject (an abstract of which was published in our issue of December 9th) was read and discussed, and in opening the discussion Prof. David Robertson thanked the authors for their interesting demonstration. The pleasure with which he had listened to the paper was increased by the fact that Mr. Martin was an old student of the Merchant Venturers' Technical College, although he could not claim him as one of his. It would seem to be quite possible to attach fish plates to railway rails by means of studs welded on by the Cyc-arc process, instead of having the rail ends drilled for the usual bolts.

Mr. W. Nairn (Bristol Tramways Co., Ltd.) was rather surprised to find welding specialists putting forward the suggestion shown on one of the slides relating to the attachment of copper bonds to rails. In tramway work the tendency was to weld the tramway rails and do away with copper bonds entirely. Railway practice was rather different, but the open type of bond shown was not a practicable proposition, as bonds fixed in that manner would be promptly removed by thieves. For railway work, a percentage of the fishplates might be welded to the rails, say, in two out of three joints, and the third or expansion joint could be bonded by direct welding a copper bond in a concealed position.

Mr. H. R. Besant (Bristol Tramways Co., Ltd.) also expressed the opinion that neither of the methods illustrated would form a satisfactory bond under the conditions of tramway practice. The first method, welding a brass stud to the rail and using a flat strip connection, would not give a permanent low resistance connection, while the alternative method shown involved the use of soldered connections, which experience had proved to be unreliable under those conditions. He suggested that a better way would be to weld the copper bond directly to the rail.

* *Journal* of the A.I.E.E., 1921, Vol. XL, p. 120.

Prof. ANDREW ROBERTSON (Bristol University) said the authors had produced a machine which did its job in a remarkably simple and satisfactory manner, and he had nothing but admiration for it. However, in view of some of the suggested applications of the system, some caution should be exercised in the interpretation of the test results of mechanical strength that had been given by Mr. Martin. Too much should not be made of the tests on studs which showed that the weld was stronger than the stud for a single application of the load. Many of the suggested applications involved alteration of stress, and to judge of the suitability of the system for loads of that character, other tests were required. Many wheels were certainly very poor when subjected to vibration or alternating stresses, and before attempting to use that system of welding for the attachment of the blades to a turbine rotor (to mention one important case), it would certainly pay to carry out tests under alternating stresses.

Mr. T. HOOD, with regard to the authors' difficulties in using their apparatus with alternating currents, felt that the frequency of the circuit must have a considerable influence on the success or otherwise of the operation, and had Mr. Martin conducted his experiments on the Bristol circuit of 93 cycles he might have secured much more satisfactory results.

Mr. A. J. NEWMAN (Bristol Electricity Department) mentioned that there seemed to be rather a mix up in the units employed, inasmuch as it was suggested that two watts were 1/600th of a Board of Trade unit. In tube-to-tube welding, one of the characteristics of the weld seemed to lie in the fact that the tube itself was partly filled up with metal, which fact limited its field of operation enormously. The chief application which appealed to him was in connection with turbine blading, as owing to the difficulties designers were labouring under at the present day in meeting market needs for cheaper plant and therefore necessitating higher peripheral speeds, the welding of the blades to the disks seemed to be an application quite worth while considering.

Mr. H. I. ROGERS, referring to the manufacture of pantograph and tube collectors, asked whether the authors had had any experience in welding tubes into sockets, as he thought there would be quite a considerable opening for the Cyc-arc process in that direction. As regarded bonding of rails, he did not think the particular methods shown by the authors would be successful, but pointed out that in bonding the rail to every fifth pole, the apparatus appeared to be very suitable and would lead to a great saving in time.

Mr. C. T. ALLAN (South Wales Power Distribution Co.) suggested the application of the process to turbine blading, colliery work, and domestic utensils and appliances. The direct welding of pins to cross-arms for attaching to poles might receive attention, as at present great difficulty was experienced through the rusting of the nuts to the pins.

Mr. A. C. MCWHIRTER (chairman) spoke of the great advantage to be derived from the process if applied to armature building. He considered it would eliminate the trouble of running solder, but thought difficulty would be experienced in the welding of large sections, as the arc would start at one spot and then miss, resulting in air spaces forming instead of metal to metal welds. If the process were applied to the cycle trade, the cost of production would be reduced 75 per cent.

Mr. W. F. CHAMEN said the process as demonstrated left a small mass of elevated brass around the stud. That appeared to be the way of making elevated joints.

Mr. H. MARTIN, in reply to some of the points raised in the discussion, agreed that the a.c. arc-striking difficulties were associated with the reversals of current flow, owing to the fact that at the time of attempting to strike the arc, the current might be actually or approximately at zero. However, satisfactory means had been evolved to overcome the arc-striking difficulty. The suggestion that rails might be bonded by the welding of the studs used in attaching the fishplates was considered to be quite a useful and feasible one, provided that other difficulties could be overcome in completing the bond. There would be no difficulty whatever in welding tubes into suitably designed sockets by means of the Cyc-arc process and apparatus. Difficulty existed in connection with an a.c. motor drive of the special kinetic generator, but in the case of a 3-phase motor, that should be satisfactorily overcome by means of a suitably designed slip resistance. It was preferred not to have to operate with a single-phase drive.

In reply to Mr. Newman, an error had not been corrected in expressing the energy consumed, when making certain welds, in watts instead of watt-hours. Though Cyc-arc welds on to cast iron could be made, such welding was not recommended on account of the unsatisfactory nature of the cast iron itself from a welding standpoint. When Cyc-arc welds on to cast iron were subjected to tensile tests they did not break, but a small piece of cast iron was drawn out with the welded stud or tube. The welding of cast iron was invariably unsatisfactory; although it could be used for stopping leakages in, or holding together, castings in which the welded portion was subject to compressive stresses, he had no faith in its use for repairs in which the welded portion was likely to be subjected in use to any appreciable tensile stress. The attaching of turbine blading to rotors by means of the Cyc-arc process raised no difficulty in designing a plant suitable for the purpose. In that connection, excellent welds of high mechanical strength could be made to cast steel, and also rustless steel was readily weldable. They were considering an important modification of their proposals, in order to enable them to come into line with existing methods of bonding as used on most of the electrified railways in this country. Their proposal now was to weld short brass or copper studs on to the rails and to attach to them, by practically the same methods as now used, the necessary copper bonds, which were fixed between the fishplates and the rails, in order to avoid their being stolen. Their bonding proposals were not being put forward for tramway work, but they were worth consideration for light railway work (including mines), more particularly abroad, where Thermit welding was either unsuitable or unnecessary. Alternating stress tests had been made of Cyc-arc welds, with the result that such welds of brass to steel appeared to give about the same results as those obtained with ordinary methods of arc welding. If the welds were annealed, however, before testing, considerable improvement had been observed. From observations and rough tests made on steel to steel welds, however, they had no fear but that they would give remarkably satisfactory results under any form of alternating-stress test. Before such welds were annealed, however, they were extremely brittle and liable to break with the slightest jar. There were no apparent means of avoiding entirely the formation of the fillets of metal surrounding Cyc-arc welds. They could, however, be readily removed by machining, but it was preferable to retain them, where possible, on account of their reinforcing properties. It was believed that the welding of both copper and aluminium could be effected by the Cyc-arc process. They quite anticipated that they would be able, at an early date, to use the process for the welding of copper in such work as rotor construction and for armature connections.

DISCUSSION AT NEWCASTLE-UPON-TYNE.

At the North-Eastern Centre of the Institution, on December 12th, the paper was read and discussed, the reading being illustrated by a number of lantern photographs and diagrams, and several welds were made upon an iron plate.

THE CHAIRMAN (Dr. W. M. Thornton) in opening the discussion, thought that the process was only at the beginning of its career; it was not quite correct to call the process welding in the ordinary way, yet he did not know what else they could call it. It was a process of melting and the introfusion of metals by an extremely active action of the electric current. It had given a new meaning to the term melting in the electric arc.

Mr. J. H. HOLMES said it seemed to him that there was a vast amount of room for the application of the method. That the services of a driller were dispensed with, they would agree, was a real advantage.

Mr. A. P. PAYNE (in a written communication that was read by the hon. secretary) said that one of the great difficulties of electric welding was the fact that the efficiency, or otherwise, of the weld was largely dependent upon the operator, who must not only be skilful, but careful. A careless workman under the inducement of piecework could very easily make a very bad weld, which would be difficult to detect. His experience, founded upon considerable use of both a.c. and d.c. welding, was that, in the hands of an expert who was used to alternating current, an a.c. weld was quite as good as one made by direct current, but it was advisable to confine an inexperienced welder to d.c., or considerable dissatisfaction might be the result. That appeared to be due largely to the spluttering of the arc with alternating current, which prevented the welder from seeing as clearly what he was doing as he would see when using d.c. The actual result was an untidy weld, and at the same time considerable burning away of the metal adjacent to the place at which the new metal was built on. Thus, in welding two plates together the joint itself might be actually stronger than the main body of the plates, and yet a considerable reduction in area might take place on each side of the weld. Neither of those difficulties arose in the process outlined by the authors, in fact, the human element, so far as the actual welding was concerned, had been almost eliminated, and they were to be congratulated on having perfected a system having a great field of usefulness. The shipyard electrical engineer was familiar with the basketfulls of broken drills and taps sent into store periodically, a source of expense which the authors' process eliminated. With regard to the use of alternating current, there appeared to be no insuperable difficulty, but one must bear in mind that its use was accompanied by much more danger to operators. No fatalities had occurred when using direct current at 250 volts and below. Alternating current of so low a voltage as 60 volts could not be regarded as entirely safe on board ship.

PROF. HOWARTH explained that the difficulty of welding in a closed circuit chemists regarded as entirely due to rapid oxidation. In the present system that was reduced to the minimum.

Mr. W. T. DALTON referred to the bonding of fish-plates of rails, and drew attention to the cramped space. There was the objection also that the drilling of holes tended to weaken the rail, and bonding over the fish-plate had been substituted to do away with that weakness.

Mr. J. A. ANDERSON said the Cyc-arc process had rather upset his ideas as to electrical welding. Previously he had thought that in welding metal to metal they had to have

a neutral atmosphere for the work, but in the present case there was no special preparation, nor special electrode.

The discussion was continued by Messrs. W. L. Lambourne, White, P. F. Allan, H. J. Fisher, H. B. Poynder, and T. Carter, and in reply Mr. H. Martin said their aim had formerly been to heat the plate; that was the very opposite to what they did now, when the aim was to get sufficient current density to maintain the arc. He agreed that the process was not strictly a welding process, but they had no other name for it. He believed that all metals, more or less, were weldable by that method; the difficulty was mechanical strength, but they were rapidly improving the process. The desirability of more chemical and metallurgical knowledge was admitted, and much work still remained to be done.

Discussion at Glasgow.

At the Scottish Centre of the Institution, on December 13th, the paper was read and discussed, and in opening the discussion Prof. Francis G. Baily, M.A., made some remarks with regard to welding temperatures, and suggested the welding of copper leads to earth plates as a possible field for the welding tool described in the paper.

Mr. A. E. Frankling, who was directly concerned and interested in ships' electrical installations, confined his remarks primarily to stud welding. The operation of stud welding was beautifully simple, and because of its simplicity there was a fear of the apparatus being turned over to an operator who, by reason of lack of initiative, disinterestedness, or personal antipathy towards it owing to its labour-saving possibilities, would not give it a fair chance. He hoped that discrimination would be exercised in the selection of operators, and also that shipbuilders would enlighten them as to the attitude which the trade unions would adopt towards that labour-saving apparatus. If it be insisted on that the men displaced by its adoption were to operate it, and if it be further insisted on that the numbers displaced by it were to be found employment in connection with its application, he feared that the apparatus would not be given the chance to which its worth entitled it. It was most important that each operator should be supplied with a simple, but reliable, apparatus for testing his work as he proceeded, and he was of the opinion that a spring-headed "L" shaped bar, the toe being provided with a coned recess for engaging with the two halves of a split coned nut to be placed over a few threads of stud, would be satisfactory for the purpose. The studs would be pulled in the direction of their length by pressing down the bar.

The authors referred to a ball-ended stud as being the most suitable for welding, but it was the speaker's experience that cone-ended studs were equally satisfactory. Owing to the cone end being of the same diameter as the threads, there would be a saving in cost on that account—a point not to be lightly set aside in view of the considerable quantities required. Moreover, they possessed the advantage of more accurately centring the stud in the position marked off for it.

The apparatus would be improved were a double-pole contactor substituted for the existing single-pole one, as by so doing the generator would be earthed only during such time as a weld was in progress. A mishap in the early days of the experiments was attributed to the lack of this precaution. The authors had been very modest in their claims as regarded the advantages possessed by that stud-welding process when compared with the method at present in use.

When perforated plating was fitted, it was customary to leave a space of about one inch between it and the bulkhead, &c., to which it might be secured, with the result that damage to cables by reason of their having been drilled into from the reverse side of the bulkhead was comparatively negligible. When cables were secured direct, as would be the case when studs were welded thereto, the risk of their being drilled into from the reverse side would be considerably increased unless precautions were taken to call the attention of all concerned to the fact that electric cables were in certain positions.

Mr. W. B. Hird thought that with certain modifications the apparatus might be adapted and made suitable for the making of joints in the windings of dynamos. A suitable welding tool for that purpose would be of great advantage in dynamo construction.

Mr. H. Martin replied generally to the discussion, stating that experience had shown that even with the largest welds there was no disturbance on the remote side of the bulkhead. Development of the process was going in both directions; on the one hand, he hoped to be able to do welding in watch and clock-making, and that would necessitate timing of the nature of 1/100th part of a second. It was almost certain also that work of three or four times the present maximum in size would soon be accomplished. Welding conductors to earth plates presented no difficulty. The Admiralty had commissioned the authors to investigate the possibilities of copper welding. While some difficulties arose in welding copper to steel, they did not appear to be insuperable. Experienced welders could detect a bad weld by inspection or ringing in almost every case. To obtain quantitative results, however, a lever-testing tool had been devised. The use of ball-ended studs was not absolutely essential, as satisfactory welds had been obtained with flat-ended ones, and he felt sure cone-ended studs would also be satisfactory. The double-pole contactor called for by one speaker did not appear to be justified, as practical experience had shown that the present design was quite satisfactory. Many instances were cited showing the general robustness of the apparatus. Welding of aluminium was unsatisfactory, and it seemed better to try alternative methods such as had been suggested for cast iron.

The Chairman, Mr. E. T. Goslin, handed over the duty of proposing a vote of thanks to the authors to one of the surviving founders of the Institution, namely,

Col. E. D. Malcolm, who said that the strength of the parent Institution and its world-wide ramifications were a source of gratification to him. He would like to be oftener at the meetings, but he stayed a long way off and travelling was difficult at his age, apart altogether from its effect on his health, which he was bound to safeguard. He complimented the authors on their paper and on the way in which it had been delivered.

THE ELECTRICAL TRADES BENEVOLENT INSTITUTION.

Annual Festival Dinner, 1921.

The following is a list of contributions received and promised up to November 30th, 1921, in connection with the Annual Festival Dinner, 1921, at which Sir Tom Callender presided :—

CHAIRMAN'S LIST.

	£	s.	d.
Agra Engineering Co. ...	0	10	0
Allen, Frank	0	10	0
Allen, H. W. ...	1	1	0
Allin, Sydney Wm. ...	0	10	6
Ames & Co.	0	10	6
Andrews (George) & Co. ...	0	10	0
Andrews & Son	0	10	6
Ashmead, F.	0	10	0
Atkinson, Llewellyn B. ...	5	0	0
Babcock & Wilcox, Ltd.	10	10	0
Bailey, Frank	10	10	0
Balfour, Beatty & Co., Ltd.	3	3	0
Barker (Henry), Ltd. ...	1	0	0
Barnard, G.	5	5	0
Barralet, Edgar S. ...	2	2	0
Barrow Hematite Steel Co.	10	10	0
Baterby & Hefford ...	0	10	6
Baughan, A. H. V. ...	1	1	0
Beaver, A. G.	1	1	0
Beecroft, E. R.	0	10	0
Beer, H.	0	10	6
Bell, A. Randall	2	2	0
Bell, Major Herbert ...	5	5	0
Bellis & Morcom, Ltd. ...	25	0	0
Benn, E. J. P.	10	0	0
Bennett, H. G.	2	2	0
Berry, H. H.	5	5	0
Bexon, W. C.	5	5	0
Bishop, W. J.	1	1	0
Blake, —	0	2	0
Bloxham, T. W.	1	1	0
Bolton (Thos.) & Sons, Ltd.	10	0	0
Booth, H., O.B.E. ...	1	1	0
Boots' Pure Drug Stores, Ltd.	1	1	0
Bowen, Tom	0	10	6
Bowerman Bros. ...	0	5	0
Bradfield, J. E.	0	10	6
Breckenell, Munro and Rogers	1	1	0
Bright, Sir Charles ...	1	1	0
British Thomson-Houston Co., Ltd.	10	10	0
Britton, S. E.	1	1	0
Bromley (Kent) Elec. Supply Co.	3	0	0
Brooking, J. H. C. ...	2	2	0
Brooking & Co.	1	0	0
Buchanan & Curwen ...	0	10	6
Cable Makers' Association	25	0	0
Callender, Sir T. O. ...	100	0	0
Callender's Cable & Cons. Co., Ltd.	100	0	0
Chappell, W. E.	1	1	0
Chattock, R. A.	3	3	0
Cheetham, —	0	4	6
Christensen, H.	0	5	0
Clarke, J.	0	10	6
Clegg, Stanley	1	1	0
Clothier, Jas. H.	1	1	0
Cochrane, H.	0	10	6
Coe, G. D.	0	10	0
Colston Electrical Co. ...	0	5	0
Cooper, A. T.	2	2	0
Cooper (Cecil)) & Co., Ltd.	1	1	0
Cramb, A. C.	1	1	0
Cray Installations, Ltd. ...	0	10	0
Crompton & Co., Ltd. ...	5	5	0
Cromwell Engineering Works	1	1	0
Cross, E.	1	1	0
Cunningham, R. N. ...	1	1	0
Cunningham, Slater, Ltd.	0	10	6
Curtis, C. L.	1	1	0
Darby, B.	1	1	0
Davies, Jenkins	0	5	0
Davies, M.	0	10	6
Davies, S. A.	0	10	6
Davis, J. W.	0	5	0
Davis & Son	0	5	0
Davonald, E. Ll.	0	5	0
Dawlish Elec. Light Co.	0	2	6
Deeble, F.	0	5	0
Dewrance, Sir John, K.B.E.	5	5	0
Dickinson, Alfred ...	5	5	0
Dixon Bros.	1	1	0
Doggett, F.	1	1	0
Don, Charles	0	10	6
Doncich, A.	0	2	6
Donnison, F. A.	1	1	0
Dorman, Long & Co., Ltd.	10	10	0
Dornbush, E. G.	3	3	0
Drake, Bernard M. ...	3	3	6
Drury & Chalfe	0	2	0
Dunn, F.	0	10	0
Durrants (Eng.), Ltd. ...	1	1	0
Eck, Justus	2	2	0
Eck, Mrs.	1	1	0
Edgecombe, J. E. ...	1	1	0
Elliston, Evans & Jackson	3	3	0
Entwistle, —	0	5	0
Esson, Mrs.	2	2	0
Evans, H. A.	0	10	0
Evans, Lewis	0	2	6
Farrow, A. E.	1	1	0
Featherstone, W. A. E. ...	1	1	0
Fell, A. L. C.	2	2	0
Ferranti, Ltd.	5	5	0
Flannery, Sir J. Fortescue, Bart., M.P.	3	3	0
Fly, F. E.	0	5	0
Folkestone Elec. Supply Co.	5	5	0
Foulds, H.	1	1	0
Franklin, R.	5	0	0
Fuller, A. J.	1	1	0
Fuller, W. H.	1	1	0
Gaff, Charles	0	10	0
Gall, J. B.	1	0	0
Garcke, E.	5	0	0
Garlick, V. O.	0	10	0
Garrard, Charles ...	0	10	0
Garside, F.	1	1	0
Garton, G.	0	5	0
Gay, Albert	3	3	0
Gates, Chas.	0	10	0
Gent & Co.	3	3	0
Gill, F. J.	1	1	0
Glover (W. T.) & Co., Ltd.	25	0	0
Good, Marriott & Co. ...	1	0	0
Gossedge, S.	0	10	0
Gott, A. B.	1	1	0
Grant & Taylor	1	1	0
Green, Nuttall & Co. ...	0	5	0
Greene, C. J.	1	1	0
Greene, R. R.	0	5	0
Greenyer, —	0	5	0
Hamer, S. T.	0	10	0
Handley, B.	1	0	0
Harris, A. F.	1	1	0
Harrison & Co.	0	10	6
Harvey, E. A.	1	1	0
Harvey, Martin T. ...	2	2	0
Haswell, C.	1	1	0
Havard, John	0	5	0
Hay, Andrew	0	10	0
Haydon (H.) & Co. ...	0	10	6
Hedgcock, A. J.	1	1	0
Hendry, W. G.	1	1	0
Henley's W. T. Telegraph Works, Ltd.	25	0	0
Heywood, Col. Ralph ...	1	1	0
Hickton, E. B. ...	0	10	0

	£	s.	d.
Highfield, J. S.	5	0	0
Higlett, G. W.	2	2	0
Hill, H.	1	1	0
Hills, Capt. R.	1	1	0
Hoare, W. H.	1	0	0
Holland, —.	0	5	0
Holmes, W. G.	0	10	0
Hood, T., & Co.	0	10	6
Horsfield, A. H.	0	10	0
Hunter, C. E.	3	3	0
Hunter, P. V.	2	2	0
Huntingdon, Capt. J.	0	5	0
Illams, T.	0	10	0
Isle & Jarrett	0	10	6
Isle of Wight Elec. Supply Co.	3	0	0
James, O.	1	1	0
James, Sydney	0	5	0
Johnson, T. O.	0	10	6
Johnson, Richard, & Nephew	5	5	0
Jones, A.	0	10	6
Jones, Glyn	0	5	0
Jones, John I.	1	1	0
Justus Eck & S. Brook	2	2	0
Kemnal, Sir James	5	5	0
Kemp, J. T.	1	1	0
Kennedy, Sir Alex. B. W.	5	5	0
Knight, W. C.	1	1	0
Lackie, W. W., C.B.E.	2	2	0
Lang, W	2	2	0
Langdon, G. H.	1	1	0
Laverick, J. W. H.	1	1	0
Leaf, Lt.-Col. H. M.	3	3	0
Lee, Edwin	0	5	0
Lee, H. Tomlinson	0	10	6
Lewis, F. Harman	1	1	0
Liley, Edward L.	0	10	0
Livesey, S	0	10	6
Lloyd, W	0	5	0
Longbotham, G. N.	1	1	0
Lord & Shand, Ltd.	1	0	0
Lucas, A.	0	10	6
Lundberg, A. P., & Sons	2	2	0
Lunn, J. P. P.	1	1	0
Lymington Elec. Supply Co.	2	0	0
Macgregor, J.	2	2	0
Mackintosh Cable Co., Ltd.	5	5	0
Maclay, J. A.	1	1	0
Maclean, A. B.	10	10	0
Malek, E. M.	1	1	0
Mallord, A. W.	0	10	0
Mann, Egerton & Co., Ltd.	5	0	0
Mansell & Oran	0	10	6
Marson, B. J.	1	1	0
Mason, G. E.	0	10	0
Massey, G. J.	1	1	0
Mavor & Coulson, Ltd.	10	10	0
May, W. R.	1	1	0
May, W. R. (Technical Staff)	2	2	0
McDonnel, —.	0	5	0
McEuen, C. H.	5	0	0
McKercher, W. A.	0	10	0
McLean, S.	1	1	0
McLellan, W.	5	0	0
McLennan, D.	0	10	6
Meads, A.	0	10	6
Medical Supply Association	2	2	0
Meggitt, F. A.	0	10	6
Melton Mowbray Elec. Supply Co.	2	0	0
Merritt, E.	0	10	6
Miller, A. Roberts	0	10	0
Monkhouse, E. W.	1	1	0
Morgan, H. T.	0	5	0
Morley, E. T.	0	5	0
Morris, P. D.	1	1	0
Morrison, F.	0	5	0
Morriss, T. E.	1	0	0
Morton, P.	0	10	0
Morton, R. C.	1	1	0
Mossop, W.	1	1	0
Mountjoy, —.	0	10	6
Murray, A.	1	1	0
Murray, Lee	2	2	0
Mylan, W. F.	1	1	0
Nalder, F. H.	1	1	0
Nalder Bros. & Thompson, Ltd.	5	5	0
Neale & Freund, Ltd.	5	5	0
Nelson, W. A.	2	2	0
Newman, A. J.	0	10	6
Newton, R. S., & Co.	0	10	0
Nicholls, W. H.	1	11	6
Nicholson, —.	0	5	0
Noble, Sir Wm.	3	3	0
North, J. F.	1	1	0
Nottingham Corporation Elec. Staff (per A. Clifford)	2	12	6
Noyes, Henry	5	5	0
Nuttall, E.	0	10	0
Oldak, F.	1	1	0
Page, Archibald	3	3	0
Panting, C. H.	1	1	0
Parker, G. H.	0	10	6
Parsons, Hon. Sir Charles, K.C.M.G.	25	0	0
Parsons, F. W.	3	3	0
Parsons, R. A.	1	0	0
Pattersen, J.	0	10	6
Paul, R. W.	2	2	0
Pearce, S. L., O.B.E.	1	1	0
Petersen, G. H.	0	5	0
Petersen, Th.	2	2	0
Phillips, A.	4	4	0
Phillips, E. A.	0	10	6
Phillips, T. T.	0	5	0
Photector Co., Ltd.	1	1	0
Pipkin, Chas.	2	0	0
Portsmouth Corporation Elec. Department	2	0	0
Potter, W. J.	5	5	0
Pragnell, A. M.	1	0	0
Pratt & Gelsthorpe	0	10	6
Preece, A. H.	2	2	0
Preece, Cardew & Rider	5	5	0
Price, S. L. R.	0	10	0
Price-Hughes, T.	0	10	6
Proctor, Sir H. E. E., C.B.E.	5	5	0
Randall, R. L.	0	10	0
Ravenshaw, H. W.	1	1	0
Rawcliffe, W. T., Ltd.	0	5	0
Rees Roturbo Co.	2	2	0
Reeves, E.	5	5	0
Reid, Wm. Douglas	1	1	0
Renwick, Sir Harry, K.B.E.	5	5	0
Reynolds, L.	0	10	6
Richards, John, & Co.	0	10	0
Richards, R. T.	0	2	6
Riggs, W	2	2	0
Riley, J	1	1	0
Robertson, J. A.	2	2	0
Roderick, —.	0	5	0
Rogers, A.	0	5	0
Rogerson, W. M.	2	2	0
Rooper, W. O.	1	1	0
Rose, H. C.	2	2	0
Rosling, Percy	12	13	0
Rowell, P. F.	1	1	0
Rumbelow, —.	0	5	0
Russell, J. W.	0	10	0
St. Austell & District E. L. & P. Co.	0	5	0
St. Helens Cable and Rubber Co.	10	10	0
Salisbury Elec. Supply Co.	3	0	0
Salomons, Sir David, Bart.	3	3	0
Sankey, P. W.	2	2	0
Savage, H.	3	3	0
Scheff, Leo.	3	3	0
Scott, A.	1	0	0
Seabrook, A. Hugh	6	6	0
Shirt, D. J. E.	3	3	0
Shirtcliffe, F. C.	0	10	6
Shoolbred & Connell	0	5	0
Sillar, A. M.	2	2	0
Simms, W.	0	10	0
Simpson, Baker & Co.	1	0	0
Sinclair, Dane	10	10	0
Sloan Electric Co.	3	3	0
Smallwood, W. H.	1	1	0
Smith, F. Fawcett	0	10	0
Smith, G. F.	1	1	0
Southey, Ltd.	1	1	0
Sparks, C. P., C.B.E., & Partners	10	0	0
Staffordshire Electrical Accessories Co., Ltd.	1	1	0
Steele, C. H.	0	5	0
Sutcliffe, J. W.	0	10	0
Symonds, R. H.	5	5	0
Tait, A. W., C.B.E.	3	3	0
Talbot, H.	5	5	0
Tanner, A. E.	5	5	0
Taplin & Sons	0	10	0
Taylor & Brigg	0	10	6
Taylor, James	100	0	0
Teasdale, J. E.	0	10	6
Tew, W. H., & Co.	1	1	0
Thomas, Bertram	3	3	0
Thomas, D.	0	2	6
Thomas, J.	0	10	0
Thomas, J. R.	0	5	0
Thomas, Lewis	0	2	6
Thomas, P.	0	10	6
Thomasson, W.	0	10	6
Thomson, J. S.	1	1	0
Thornton, S.	0	5	0
Thurley, G. F.	0	2	6
Todd, Rowland G.	0	5	0
Trevor-Roper, L. C.	1	1	0
Truscott, Sydney	0	5	0
Turner, W. G.	1	1	0
Tyler & Freeman	5	5	0
Udall, A. H.	0	5	0
Union Cable Co., Management & Staff	15	0	0
Urban Elec. Supply Co.	5	0	0
Urban E. S. Co., Newton Abbott	0	10	6
Vivian & Son	0	5	0
Walker, P.	2	2	0
Wallis, C.	2	2	0
Wallis-Jones, Capt. R. J., O.B.E., T.D.	1	1	0
Walmsley, J.	0	10	6
Walton, W. H.	2	2	0
Wansborough, E. C.	1	1	0
Watson & Childs	0	10	6
Watson, J. Francis	1	1	0
Western Electric Co., Ltd.	10	10	0
Whalling, S. F.	1	1	0
Whitehouse, C. F.	0	10	0
Wickham, W. H.	2	2	0
Wilkes, John, Son and Mapplebeck	5	5	0
Wilkins, F.	1	1	0
Wilkinson, Mrs.	0	5	0
Willey, J. T. E.	0	10	0
Williams, C.	1	1	0
Williams, D. N.	1	1	0
Williams, M.	0	10	0
Williams, T.	0	5	0
Wilson, A. E.	1	0	0
Wimhurst, W. E.	1	0	0
Woodhouse, W. B.	2	2	0
Woodmason, W.	0	10	0
Woods, H. F. G.	0	10	6
Woolnough, F.	0	10	0
Woradell, F. E.	1	0	0
Wycombe Electric Supply Co.	3	0	0
Electrical Wholesalers Federation (collected from Members and Staff by Mr. S. G. Leach)	46	10	0
Sundry small Contributions	6	3	9
	£1,156	7	3

MR. A. H. ALLEN'S COLLECTION.

	£	s.	d.
C. A. Baker	1	0	0
Braby, Ivon	1	1	0
"Electrical Review"	21	0	0
Futers, T. Campbell	1	1	0
Gatehouse, E. A.	1	1	0
Spiers, C. W.	1	1	0
Walrond, C. T.	0	10	6
	£26	14	6

MR. H. BEVIS'S COLLECTION.

	£	s.	d.
Bevis, H.	2	2	0
Driver & Co., Ltd.	1	1	0
General Rubber Co., Ltd.	2	2	0
Gorton & Halliday	2	2	0
Hearl, Heaton & Sons, Ltd.	5	5	0
Heilbut, Symonds & Co.	10	10	0
Knowles, George, & Co.	2	2	0
McConnel & Co.	1	1	0
Morice, Tozer & Beck, Ltd.	5	0	0
North-Western Rubber Co.	1	0	0
Pirelli, Ltd.	5	5	0
Round Oak Works, Ltd.	1	1	0
Smith, Fred., & Co. (Manchester)	2	2	0
Stern, Alfred	1	1	0
Stott Bros.	5	5	0
	£46	19	0

MR. CHARD'S COLLECTION.

	£	s.	d.
Anderson & Robertson, Ltd.	3	3	0
Black, T. F.	1	1	0
British Oil & Turpentine Corpn., Ltd.	2	2	0
Campbell, MacMaster & Co.	1	1	0
Douglas, H. D., & Co.	1	1	0
Eds & Townsend, Ltd.	1	1	0
Espir, Fernand	1	1	0
Farnan, H. F., & Co., Ltd.	2	2	0
Gabriel, Wade & English, Ltd.	1	1	0
Gardner, Henry, & Co., Ltd.	5	5	0
Hill, Craven & Hay	1	1	0
Hill, H. C.	0	10	6
Hodge, E. A.	2	2	0
Jones, Edwin, & Co., Ltd.	2	2	0
Langley, Smith & Co.	1	1	0
Lankester & Sons, Ltd.	1	1	0
Lindsay & Williams, Ltd.	5	5	0
Osborn & Co.	1	1	0
Pearson & Knowles's Coal & Iron Co.	2	2	0
Reading Boiler Setting Co.	0	10	6
Rowland, H. C., & Co.	0	10	6
Schnurmann, J.	2	2	0
Smith, Fredk., & Co., Ltd.	2	2	0
South-Western Tar Distilleries	5	5	0
Stromwall & Co., Ltd.	2	2	0
Taylor, Bros. & Cox, Ltd.	2	2	0
Tagart, Morgan & Coles, Ltd.	1	1	0
Trafalgar Engineering Co., Ltd.	1	1	0
Wakeman, F.	1	1	0
Walker, George, & Co., Ltd.	1	1	0
Warren, Henry F.	2	2	0
	£56	3	6

MR. J. W. ELLIOTT'S COLLECTION.

	£	s.	d.
Chisholm, J. W.	1	1	0
Edison Swan Works	4	4	0
Elliott, J. W.	1	1	0
Etches, G. B.	1	1	0
Maddick, —.	1	1	0
	£8	8	0

MR. J. Y. FLETCHER'S COLLECTION.

	£	s.	d.
Amberg, V.	1	1	0
Boyd, W. R. E.	1	1	0
Boyes, F.	1	1	0
Cheyne, A. J.	0	10	0
Crawford, F.	1	1	
Crush, F.	1	1	0
Fletcher, J. Y.	26	5	6
Hermes, L.	2	2	0
Hirst, Edward	1	0	0
Holt, L. C.	1	1	0
Jepson, A. E.	1	1	0
Kramer, J. B.	1	1	0
Phelp, J. A.	1	1	0
Railing, Dr.	1	1	0
Richards, W. L.	1	1	0
Sims, P. J.	1	1	0
Smith, T.	1	1	0
Thames Paper Co., Ltd.	5	0	0
Wilson, E.	1	1	0
Winder, R. F.	1	1	0
Wink, J.	1	1	0
G.E.C. Manchester Office	3	6	6
	£55	0	0

MR. W. E. HOBBS'S COLLECTION.

	£	s.	d.
Bealey, C. A.	1	1	0
Dixon, L. W.	1	1	0
Eastwood, J. W.	0	5	0
Elliott, W.	1	1	0
Hobbs, W. E.	1	1	0
McWhirter, A. C.	1	1	0
Moffat, J., & Co., Ltd.	1	5	0
United National Collieries, Ltd.	2	2	0
	£8	17	0

MR. R. W. HUGHMAN'S COLLECTION.

	£	s.	d.
"Electrical Times," Ltd.	5	5	0
Hughman, R. W.	1	1	0
Napier, T. Disney	0	10	6
Tapper, W. C. P.	1	1	0
	£7	17	6

MR. W. C. JEARY'S COLLECTION.

	£	s.	d.
Anns, —.	0	1	0
Astbury, —.	0	1	0
Beman, A.	0	5	0
Edwards, C.	0	2	6
Fifield, —.	0	1	0
Franhauser, C.	0	10	6
Franks, F. O.	1	1	0
Hoare, D. H.	0	2	6
Jeary, W. C.	1	1	0
Jeary Electric Co., Ltd.	5	5	0
Leavin, L. C.	0	2	6
Neville, Guy	0	5	0
Roberts, E.	0	10	0
Saunders, —.	0	1	0
Story, R.	0	2	6
Telga, N. W.	1	1	0
Toomey, —.	0	1	0
Wolf, F. A.	2	2	0
Zeelander, N.	1	0	0
	£13	15	6

MR. E. F. JOHNSON'S COLLECTION.

	£	s.	d.
Croggon & Co.	2	2	0
Dwyer, P. S.	2	2	0
Hawkins Bros. & Co.	1	1	0
Johnson, E. F.	1	1	0
Plutte, F.	5	5	0
Silcock, Chas.	1	1	0
	£12	12	0

MANCHESTER AND DISTRICT LOCAL ADVISORY COMMITTEE.

	£	s.	d.
Baxendale & Co.	3	3	0
Kirkham, W.	1	1	0
Wardle Engineering Co.	5	0	0
Farthing, J. H.	2	2	0
Phillips, E. Dinsdale	1	1	0
Watson, W. D.	0	10	6
	£12	17	6

NEWCASTLE AND DISTRICT LOCAL ADVISORY COMMITTEE.

	£	s.	d.
Clothier, H. W.	2	2	0
Hatton, E.	2	2	0
Mountain, W. C.	10	0	0
Robson, R.	2	2	0
Short, M.	1	1	0
Spence, J.	2	2	0
Wyand, F. W.	1	1	0
	£20	10	0

MR. L. G. TATE'S COLLECTION.

	£	s.	d.
Edelsten, W. A.	1	1	0
Electrical Installations, Ltd.	5	5	0
Middleton, V. G., & Co.	5	5	0
	£11	11	0

MR. S. D. WHITE'S COLLECTION.

	£	s.	d.
Ever-Ready Co., Great Britain	3	3	0
Hadcock, Parker & Co.	1	1	0
McLagan, Donald	2	2	0
	£6	6	0

£1,443 18 9

Radium in Brazil.—Mrs. Alexander Grosse, F.R.G.S., has just returned from Brazil, from an expedition into the interior, where she reports that she has discovered radium deposits.—*Morning Post.*

NEW PATENTS APPLIED FOR, 1922.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

14. "Ignition systems for internal-combustion engines." W. G. M. Ross. January 3rd.

18. "Cleats and cleat bases for electric conductors, &c." A. Kirk and R. C. Milliken. January 3rd.

19. "Mine signalling apparatus." J. W. Strong. January 3rd.

44. "Electric bell, &c., indicators." J. H. Collings, M. J. Railing, and C. W. Saunders. January 3rd.

63. "Sparking plugs." W. C. Piggott. January 3rd.

65. "Electric motor controllers." British Thomson-Houston Co., Ltd. (General Electric Co.). January 3rd.

86. "Intermittently operating electric circuit closing devices." C. J. Evans. January 3rd.

131. "Electrical apparatus." P. Alexander and C. W. C. Beckman. January 3rd.

132. "Combined portable electric radiator and projector." M. Tcharny. January 3rd.

146. "Electric switches." W. W. Burnham. January 3rd.

178. "Hand wheels." British Thomson-Houston Co., Ltd., and A. P. Young. January 3rd.

179. "Couplings for insulators." British Thomson-Houston Co., Ltd. (General Electric Co.). January 3rd.

200. "Electric make and break connections and manufacture of same." J. B. Tucker. January 3rd.

202. "High-frequency telephony, telegraphy, &c." E. Pollock. January 3rd.

207. "Means for effecting phase adjustment of electrical systems." F. E. Pernot and L. J. Rich. January 4th.

228. "Electrical apparatus." A. P. Addison and J. W. A. Waller. January 4th.

242. "Ignition timing of internal-combustion engines." London General Omnibus Co., Ltd., and O. W. J. Watson. January 4th.

267. "Magneto electric machines." British Thomson-Houston Co., Ltd., and A. P. Young. January 4th.

273. "Dynamo-electric machines." W. B. Sayers. January 4th.

296. "Explosion proof fuse." E. C. R. Marks (Goodman Manufacturing Co.) January 4th.

297. "Controlling devices for electric locomotives." E. C. R. Marks (Goodman Manufacturing Co.). January 4th.

308. "Combined phonograph and electric lamp." E. de Vries. January 4th.

337. "Electric apparatus for separating or classifying finely divided materials." H. W. Cox. January 5th.

350. "Current collectors." C. B. Buchanan and C. C. Johnson. January 5th

356. "Electro-magnetic clutches." C. F. Shanks. January 5th.

361. "Enclosed cartridge fuses for electric circuits." E. J. Peirce. January 5th.

362. "Fuse carrier for distribution boards." W. Gee. January 5th.

370. "Telephonic transmitters." A. J. Roberts. January 5th.

374. "Electric fittings and means for fixing same." F. C. Raphael. January 5th.

385. "Anti-vibration devices for electric lamps, gas mantles, &c." E. W. Lancaster. January 5th.

395. "Thermo-electric lamps." E. C. R. Marks (Fabbrica Apparecchi Elettrici F. E. R. T.). January 5th.

397. "Apparatus for wireless telegraphy and telephony." R. Herzog and C. Lorenz Akt. Ges. January 5th. (Germany, July 2nd, 1921.)

407. "Heating element for electric radiators, cookers, &c." G. P. Symons. January 5th.

416. "Holders for electric incandescent lamps." W. Cunningham and F. L. Shaw. January 5th.

418. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. January 5th. (United States, March 16th, 1921.)

421. "Electric high-frequency signalling." A. van T. Day. January 5th. (United States, January 25th, 1919.)

423. "Electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampen fabrieken. January 5th. (Holland, June 13th, 1921.)

424. "Electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampen fabrieken. January 5th. (Holland, August 16th, 1921.)

425. "Electric discharge tubes." Naamlooze Vennootschap Philips' Gloeilampen fabrieken. January 5th. (Holland, November 5th, 1921.)

426. "Electric resistances." Naamlooze Vennootschap Philips' Gloeilampen fabrieken. January 5th. (Holland, January 14th, 1921.)

427. "Manufacture of electric insulating sheets or layers." Naamlooze Vennootschap Philips' Gloeilampen fabriken." January 5th. (Holland, August 8th, 1921.)

462. "Device for automatic recording of telephone calls." T. M. Ryan. January 6th.

475. "Automatic electrical sub-stations." Metropolitan-Vickers Electrical Co., Ltd. January 6th. (United States, March 14th, 1921.)

482. "Trolley wheels for electric current collectors." G. H. Boot. January 6th.

486. "Electric starters for internal-combustion engines." Scintilla. January 6th. (Switzerland, January 15th, 1921.)

488. "Electro-magnets." Siemens Schuckertwerke. January 6th. (Germany, February 16th, 1921.)

496. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. January 6th. (United States, May 3rd, 1921.)

500. "Electric high-frequency signalling." A. van T. Day. January 6th. (United States, July 17th, 1916.)

509. "Sound amplifiers for talking machines." A. Benoit and J. L. Mathieu. January 6th.

510. "Manufacture of sound amplifiers for talking machines." A. Benoit and J. L. Mathieu. January 6th.

513. "Electric switches." C. Oliver. January 7th.

516. "Drive for dynamos or magnetos of motor cycles, &c." P. C. Hanks. January 7th.

518. "Automatic valves or switches." G. Wilkinson. January 7th.

522. "Electric tumbler switches." J. P. Annacker and S. Fildes. January 7th.

523. "Devices for enabling forces due to variations in electrical energies to be used." A. R. Angus. January 7th.

526. "Electric lamps." J. Wilson. January 7th.

567. "Process for improving electrolytic mercuric oxide." Elektrizitatswerk Lonza. January 7th. (Switzerland, January 8th, 1921.)

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1920.

16,274. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., P. T. Bates, R. Mercer, and C. Gillings. June 16th, 1920. (Cognate application 28,143/20.) (172,995.)

17,144. "Electric diaphragm alarms." Apollo Plug Manufacturing Co., Ltd., and F. Brown. June 24th, 1920. (172,996.)

17,471. "Electro-magnetic relays." Creed & Co., Ltd., and T. Lenaghan. June 26th, 1920. (172,998.)

18,607. "Electrical signalling." L. de Forest. April 17th, 1919. (146,491.)

19,756. "Electro-magnetic wave navigational or direction-finding systems." Ges. fur Drahtlose Telegraphie. October 23rd, 1918. (Addition to 140,629.) (147,753.)

19,812. "Construction and operation of dynamo-electric machines." V. G. Apple. April 23rd, 1917. (147,784.)

20,400. "Thermionic tube electro-magnetic wave generating apparatus." Ges. fur Drahtlose Telegraphie. October 29th, 1918. (Addition to 148,447.) (148,445.)

20,402. "Thermionic tube electro-magnetic wave generating arrangements." Ges. fur Drahtlose Telegraphie. September 9th, 1918. (148,447.)

20,815. "Wireless telephony systems." Soc. Francaise Radio Electrique. October 26th, 1916. (148,955.)

21,481. "Electric arc welding apparatus." Siemens Schuckertwerke Ges. August 19th, 1919. (149,951.)

23,442. "Telephone systems." Western Electric Co., Ltd. (Western Electric Co., Inc.). August 10th, 1920. (173,009.)

23,470. "Submersible dynamo-electric machines." E. L. W. Byrne. February 11th, 1921. (Cognate applications, 29,380/20, 34,537/20, 4,801/21, and 10,799/21.) (173,010.)

23,814. "Ignition devices for internal-combustion engines." M. J. B. Barbarou. September 20th, 1919. (151,257.)

26,104. "Electrolytic cells, more especially intended for use in the production of the chlorates of the alkali metals." J. T. Barker and United Alkali Co., Ltd. September 10th, 1920. (173,028.)

26,373. "Electric calling or time alarm devices for use in hotels and the like." E. R. Smith. September 14th, 1920. (173,033.)

26,467. "Apparatus for seat control and recording for places of public entertainment as kinemas, theatres, and such like buildings." W. H. Tripp. September 15th, 1920. (173,036.)

26,653. "Fitting for tubular electric lamps." E. T. R. Murray. September 17th, 1920. (173,052.)

26,888. "Oil-immersed transformers." British Thomson-Houston Co., Ltd., and W. J. Boddy. September 21st, 1920. (173,062.)

27,012. "Electric starting device for internal-combustion engines." O. Y. Imray (legal representative of O. Imray, deceased) (R. Bosch Akt. Ges.). September 22nd, 1920. (Addition to 2,815/20.) (173,066.)

27,984. "Electric apparatus for the permanent waving of hair." G. Boudou. March 26th, 1920. (160,746.)

28,208. "Deferred action dry battery." E. C. R. Marks (National Carbon Co. Inc.). October 5th, 1920. (173,089.)

28,665. "Electrical oil switches." G. E. Gittins and Metropolitan-Vickers Electrical Co., Ltd. October 9th, 1920. (173,089.)

28,698. "Engine starters of motor cars, vehicles, and the like." A. Harwood. October 11th, 1920. (173,100.)

30,028. "Means for protecting alternating electric current apparatus." H. Pearce. October 23rd, 1920. (173,125.)

30,641. "Washing machines." British Thomson-Houston Co., Ltd. (General Electric Co.). October 29th, 1920. (173,127.)

31,427. "Driving mechanism for wringers and the like." British Thomson-Houston Co., Ltd. (General Electric Co.). November 6th, 1920. (173,131.)

31,676. "Systems of electric power transmission." British Thomson-Houston Co., Ltd. (General Electric Co.). November 9th, 1920. (173,134.)

34,809. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd. December 20th, 1919. (155,823.)

Electrically-produced Hay.—The scientific correspondent of the *Daily News* states that recently a method was worked out in Switzerland for preserving newly-mown grass without first drying it in the sun. The newly-mown grass is stored on metal sheets in silos of about 400 cubic feet capacity. The top of the silo is closed by another metal sheet, and the sheets at the top and bottom of the silo are connected in an electric circuit, so that alternating current at a pressure of from 200 to 500 V is passed through the grass between them. The effect of passing this current for several days is to kill all the microbes whose presence would otherwise cause the damp grass to decay. It is claimed that the process enables the grass to be preserved in its natural state until required, and that in addition it can be cut and stored irrespective of weather conditions, and it contains twice the nutriment of an equal quantity of hay. From 130 to 200 kilowatt-hours are sufficient to treat five tons of grass.

An Electrical Weather-Watcher.—A London police court case on January 9th revealed that the prosecutor was a "weather observer" for the City of London Electric Light Co. "For the past twenty years we have employed a look-out man, usually an ex-seaman, to keep us posted regarding changes in climatic conditions," said an official of the company to a *Daily Mail* reporter. "He is stationed in a glass-domed cabin, high above the city's smoke, where he keeps an unceasing vigil from 8 a.m. to 6 p.m. If a heavy fog is imminent he signals to the power-house, and arrangements are at once made to meet any consequent emergency. He is also charged with the duty of reporting on any of the company's chimneys that may be smoking. By this means we save fuel and avoid vitiating the atmosphere."

We drew attention to this practice many years ago, but probably many of our readers are unaware of the existence of this little-known occupation.